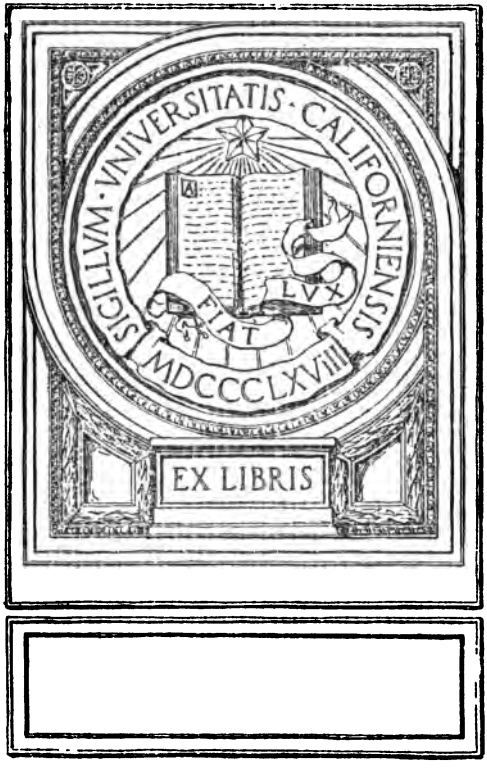

COST ACCOUNTING TO AID PRODUCTION

A PRACTICAL STUDY OF SCIENTIFIC COST ACCOUNTING

BY

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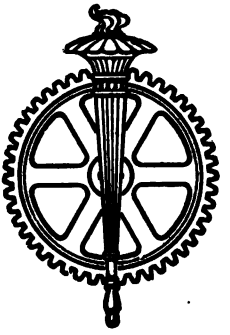

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FOREWORD

THINKING, as a power to achieve actual results, was never more strikingly forced upon the attention of peoples than during the past years of war. The care with which military commanders fostered the morale of their men, and the great efforts made by political leaders to mold and direct public opinion, will always be remembered by those who watched and studied the progress of that great conflict. In contrast, enemy nations sought to implant their own ideas, wishes, and points of view, as one of the potent weapons of warfare. The process thus used in attempting to influence men's minds, and thus their actions, we call propagandizing, and the letters, articles, pamphlets, books, and posters propaganda. Unfortunately however a sinister meaning has come to be attached to these terms, but nevertheless men of progressive thinking have always tried to tell and show to others their ideas and convictions and so exert an influence over their actions. All of this is normal and commendable. It is the abuse of this process, its perversion to ignoble or wrong purposes, that should be condemned, and it is therefore, sincere commendation to refer to the work of Mr. G. Charter Harrison as propaganda in the great field of productive industry.

Many of the early efforts at industrial management were inspired by the needs of the accounting function of a manufacturing business. It was realized that a knowledge of costs was essential in meeting competition and in making sure that the business was stable. So, many of the attempts at bettering industrial organization and management sprang out of an effort to secure accurate costs. But, generally speaking, professional accountants seem to have failed to fit their own work into the broad scheme of productive industry. And this has been permitted in spite of the teachings of many of the engineers who first entered the industrial field and who were compelled to develop cost accounting as one branch of their own work.

Notably, Frederick W. Taylor and Harrington Emerson developed cost work, and wrote emphasizing the place of importance that costs occupy in the general scheme of management in industry.

During the past decade there has been a gradual widening of the divergence of viewpoint between many of the leaders in management and engineering and cost accounting. The engineers have been working under tremendous pressure. Production has been the keynote of all their efforts and the demand for goods has been insistent and insatiable. Under these circumstances it has been quite natural to reach out for every possible help to increase and improve the productive process. So engineers have wanted cost accounting methods that would aid in reaching toward the great objective of industry.

In contrast, the cost accountants have seemed to be solely interested in securing accurate, refined cost history of what has actually taken place in the processes and operations of production. In the midst of this separation of viewpoints, this lack of harmony between men with objective and subjective minds, came the writing and work of a chartered accountant, with some twenty years of professional experience of which some fourteen years have been spent in the United States and who boldly supports the point of view of the engineers. Mr. Harrison recognized that the objective of industry is the production of goods, that everything that hampered the productive process should be eliminated, that impatience with a factory system or detail that hindered, or at least did not help, production was natural, and that cost accounting, instead of being static in accumulating history, should be an active part of the great process of production. Fearlessly thinking and writing, he condemned the attitude of many of his fellow accountants, telling them that their practice was twenty-five years behind the times, that they were making themselves slavishly subservient to a financial condition in industry that must pass away, and declared to them that if cost accounting was to hold its own among the business professions, it must turn over a new leaf and prepare to serve in "The New Industrial Day."

Looking through the form and semblance of things he declared, further, that cost accounting was unworthy of any place in industry if it did not contribute to production, and, not content with stopping at this point, he re-enforced his challenge by pointing out better and improved methods, by showing the way in which cost accounting could become an aid to production.

In all this work he has endeavored to stimulate and arouse the thinking of men, realizing that as the years pass greater progress can be secured by this means than by working for the adoption of any particular accounting scheme or plan.

In a series of articles published in *Industrial Management* in 1918 and 1919, he developed the advantages, in fact the necessity, of predetermined costs. Then he showed how to establish cost standards and use them to control costs in the making. And, he developed the theory of standardized cost formulas and presented a number of these arranged in such a manner that the little skilled office employee would be able to work out accurate results in carrying forward a cost accounting system based on the determination of standard costs and the comparison of actual costs with these standards.

All of this work has the touch of stern reality, for Mr. Harrison has applied these methods in his own consulting practice and in widely different industries, so far apart as the tonnage production of steel and the building of complex, agricultural machinery.

From this fearless thinking, from this willingness to write boldly of the truth as he sees it, from this earnest desire to advance his own profession of cost accounting and to assist in the up-building of productive industry, Mr. Harrison has written his book, "Cost Accounting to Aid Production." Its purpose is avowedly to provoke the thinking of others, in this respect differing from practically all of the preceding literature on cost accounting. Two features of the method of treatment add interest and charm. Generous credit is given to engineers who have written on cost-accounting topics, even although they may have condemned much that is looked upon as accepted in cost-accounting practice. The other attractive feature is the frequent and generous references to philosophic writings, showing that the principles underlying cost accounting can be interpreted in terms of those things that we recognize as the very truths of life. Far too few technical and engineering authors permit themselves to depart from the narrow limits of their topics, and in exercising this restraint they fail to make their own work conform to the great concepts of truth that are the heritage of all.

No reader will be able to lay down this book without feeling anew the essential responsibility of industry in present day human life, nor without a renewed realization that every part of the great professions, which are working for the carrying

on of productive industry, is but a section of a great whole and must be united in the closest of harmonious coöperation with all the others, else much less than the best will be achieved. It is easy to suspect that it was one of Mr. Harrison's wishes to leave some such impression upon the minds of those who are fortunate enough to pick up and read through what he has written.

L. P. ALFORD.

New York, N. Y.,
August, 1920.

INTRODUCTION

IN a number of articles appearing in *Industrial Management* between October, 1918 and March, 1920, which have been revised and elaborated to form the present volume, the author presented a serious and far-reaching indictment of the commonly accepted methods of cost accounting. In these articles he claimed that the methods of cost accounting, which are taught in what are regarded as the standard works on this subject, are incorrect in principle, unscientific, inaccurate, and inadequate, in brief, absolutely unsuitable to meet the needs of modern business.

The author does not claim however to be the first to disclose the fundamental defects underlying the established methods of cost accounting. Ten years ago in the pages of *Industrial Management* Mr. Harrington Emerson presented a clear and convincing indictment of the usual retrospective cost accounting methods and other writers since that time, notably the late Mr. H. L. Gantt, have forcibly demonstrated the shortcomings of the average cost system to meet the needs of industry. Such criticisms as have been made however have emanated from the engineering and not the accounting profession and while the critics have generally displayed a very complete understanding of the defects in cost accounting methods, practical advice as to the solution of the accounting problems involved in the correction of these defects has been notably lacking.

In his efforts towards the bringing of cost methods into line with modern industrial thought the author had the distinct advantage of possessing an extensive experience in professional accounting work combined with a fairly intimate acquaintance with the problems of manufacturing, the latter being gained in part through his activities as comptroller of a large manufacturing business, as the head of the system division of one of the leading firms of professional accountants, and for a number of years as a consulting accountant.

The methods formulated by the author and described in the following pages represent an absolute revolution in the basic conception of the functions of a cost system—whereas the common idea of costs is confined to the compilation of information as to past events, under the author's methods all costs are predetermined. These methods represent the application of the scientific management idea in cost accounting—not the restricted and far too common idea of scientific management which considers this as being merely a system of shop management but the broader conception which regards scientific management as representing the fundamental change in the viewpoint of industry from that of retrospection to prospection.

In the opening chapter the author states that "it is probable that the average cost system, taking into account all factors, is not more than 50 per cent efficient, so that the annual loss from this cause may well be regarded as a matter of considerable importance." That this statement is a highly conservative one will hardly be disputed by those best in a position to judge and, surely, if one half of the money annually spent in cost accounting is to be regarded as a preventable waste, the amount involved represents a serious drain upon industrial life. But this direct loss is trifling compared with the indirect one resulting from the fact that the average cost system does not disclose inefficiencies which therefore remain uncorrected owing to ignorance of their existence.

Cost accounting at the present time occupies an anomalous position. On the one hand there is the engineering profession, which knows what is required but does not understand accounting technique, claiming that cost accounting is out of tune with industrial effort, and on the other hand there is the accounting profession, trained in the development of accounting mechanism, but apparently indifferent to the fact that in clinging to obsolete ideas it is a brake on the wheels of industry. One has only to read the cost accounting literature of the last few years to realize that most of it is merely a rehash of old ideas, and that the writers have not appreciated that revolutionary changes in industrial methods demand corresponding changes in cost accounting. Useful in many ways as are the habits of thought resulting from the training of professional men along standardized lines, there is the danger that thinking will become more or less stereotyped and a condition of mental inertia result.

History is full of instances of the positive refusal of the human mind to travel along a different line to that in which

it has been accustomed to follow. About a century and a half before the birth of Christ, Ptolemy expounded his theory of the order of the universe. According to this theory the earth was the center of the universe, around which the sphere of the heavens revolved from east to west, carrying all celestial objects with it once every twenty-four hours. This was regarded as an eminently satisfactory doctrine, for obviously the idea that they were situated at the very hub of the universe, so to speak, was pleasing to the people of those days and further was not the theory proven by the evidence of their own eyes? Did not they see the sun every morning make its appearance in the east and slowly travel towards the west?

About 1500 years after Ptolemy's time, however, there came into the world one of those inquiring souls who do not take things for granted. Copernicus, the father of modern astronomy, announced to an unbelieving world that the ideas advanced by Ptolemy were all wrong; that the world was not the center of the universe; that the sun did not revolve around it and that the apparent movement of this luminary across the horizon was due to the revolution of the world upon its own axis. This discovery did not receive an enthusiastic reception for obviously, it was not easy to eradicate an idea which had been fixed for 1500 years, and for nearly 150 years after Copernicus published his great work on the revolution of the celestial bodies it was kept on the index of prohibited books of a great church as being subversive of the truth.

It is easy, of course, to understand how the rank and file of mankind would find it difficult not only to totally reverse a conception current for centuries but also to accept a theory which was contrary to what their own observations would lead them to believe, but the significant fact is that those who should have been in a position to fully appreciate the arguments of Copernicus held so tenaciously to their old ideas that over seventy years after Copernicus advanced his theories they were pronounced by a body of learned men as being "absurd in philosophy."

As a matter of fact, however, it is not surprising that the strongest opposition to the acceptance of any revolutionary idea should often come from the ranks of specialists in the particular field of thought affected. The learned men who denounced the theories of Copernicus doubtless honestly believed that they had given these theories impartial consideration, but so firmly were the old ideas intrenched in their minds, so deep the

grooves worn by the habitual trend of their thoughts in the matter under review that they were not really capable of passing an unbiased judgment.

It is no easy matter to abandon the old mental tracks along which the accustomed trains of thought run so easily and smoothly, and if even scientists whose religion is the pursuit of knowledge for its own sake find it difficult to embrace the new merely because it is unfamiliar, how much harder must it be for those whose selection of their vocation has been prompted more by utilitarian motives than by an insatiable thirst for knowledge. In such a case, as is to be expected, there is a natural reluctance to changes which will disturb the existing order of things and it is not therefore at all surprising that professional men are often ultraconservative when it comes to embracing new truths and casting out the errors and half-truths of yesterday.

As the author sees it, the solution of the problem is largely in the hands of the manufacturing executive. If he demands certain results from the professional accounting advisers he employs to formulate methods of cost accounting and refuses to be satisfied with anything short of these demands the self-interest of the accounting profession will force a readjustment of its ideas in connection with cost accounting. If, on the other hand, the manufacturer is satisfied with systems of cost accounting designed without any real appreciation of the requirements of modern industry, the development of cost accounting will be the result of a slow process of evolution. The question of paramount importance is whether the American business man can afford to wait for a leisurely solution of so vital a problem.

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THE APPLICATION OF SCIENTIFIC MANAGEMENT

Chapter I

SHOULD a manufacturer be told by a competent adviser that one of his machines performing an important operation was grossly defective in design, and while expensive to operate was turning out a relatively low production of a poor grade of product, he would not be satisfied until he had learned full details of where the trouble was and had taken the necessary steps to correct it.

One of the most important and expensive machines of the average manufacturer, however, is in just the condition indicated—it is costing more, often far more than it should, to produce very much less than he is entitled to expect from it. The machine referred to is the cost system—the mechanism for producing vital information relative to the operation of the business. Curiously enough, while all other branches of industrial management have made marked progress in the last few years, cost accounting methods in general have made no material advance.

It would be futile to estimate the total loss involved in inefficient methods of cost accounting, but it is probable that the average cost system, taking into account all factors, is not more than 50 per cent. efficient, so that the annual loss from this cause may well be regarded as a matter of considerable importance. If the same economic loss involved in inefficient methods of cost accounting were found to result from defective technical practice, a large proportion of the engineering profession would undoubtedly be exercised in finding some means of eliminating this unnecessary tax upon industry.

The continuance of this condition of inefficiency has apparently been due to the fact that the manufacturer has not

recognized its existence and though in some cases he has realized in a vague way that he was spending a lot of money for the information his cost system has furnished, he has accepted the assurance of his cost accountant that the methods adopted conformed to the commonly accepted standards. A manufacturing business cannot be safely operated without some information relative to costs. This fact is generally realized by manufacturers and the existing methods have doubtless been retained in many cases on the assumption that any cost system is better than none at all.

Professional accountants, who should obviously be the leaders in the development of cost accounting methods, have failed in a marked degree to read the "writing on the wall," and in spite of the fundamental changes in manufacturing methods introduced in recent years have made few contributions of importance toward the revision of cost accounting methods to conform to these industrial developments.

It is true that there is an endless amount of literature on the subject of cost accounting, but it follows the beaten trail and though some improvements have been made in the methods for distributing burden, it is claimed that the present generally accepted methods of cost accounting are in as retarded a state of development as were those of manufacturing previous to the introduction by Frederick W. Taylor of the idea of scientific management. In this connection reference may be made to a recent book on accounting, written by a recognized leader of the accounting profession, a chapter of which is devoted to the problems of cost accounting, but neither in this nor the rest of the book is any reference made to the important changes in manufacturing methods which have resulted from the adoption of scientific management principles, and to the steps which should be taken to bring cost accounting methods generally into line with these developments.

Occasionally there will be found professional accountants who seem to fully appreciate the fact that the cost accounting methods of to-day represent little if any advance over those current ten years ago. Practically all other branches of industrial management have experienced radical changes in recent years but it does not seem to have occurred to accountants that cost accounting also requires to be revolutionized in order to conform to the new order of things and in commenting on the slow advance which cost accounting methods in general have made they have apparently assumed that progress in this science

must necessarily be a process of exceedingly slow development whereas what is required and urgently so is not a gradual evolution in methods but a complete and speedy revolution in principle.

This viewpoint of professional accountants as regards the status and future of cost accounting is well reflected in the following somewhat plaintive remarks taken from a recent review in a leading accounting journal:

> To a reviewer of books on accounting, however, there soon comes a sense of slight weariness so aptly termed in trench-slang as "fed-uppedness" as book after book proves to be an old friend with a new face. He is almost tempted to exclaim with the preacher: "There is nothing new under the sun." In the nature of things connected with an art based upon a few fixed principles this is to be expected. All that one can do is to bear in mind that improvements in accounting methods are always possible but evolve by almost imperceptible degrees.

The engineering profession, however, has very clearly perceived many of the defects and absurdities of the established methods of cost accounting, and in no case have these been better demonstrated than by Mr. Harrington Emerson in his work entitled "Efficiency as a Basis for Operation and Wages." In the numerous volumes on scientific management and cost accounting which have appeared since that book was published it is surprising to find so little information along constructive lines as to the methods to be followed in order to put into practical operation the ideas advanced by Mr. Emerson.

As to whether the efficiency engineer ignored the accounting profession, or called upon it in vain for assistance in solving the accounting problems associated with his work of introducing the principles of scientific management, is a question that the author is not in a position to answer. In endeavoring, however, to solve these problems without the assistance of skilled accountants, as many engineers have done, they have apparently overlooked the fact that though accounting is an art based upon a few simple principles, the effective application of these principles calls for years of study and practical experience. In fact, when the engineer wanders into the domain of accounting he is apt to present as diverting a spectacle as would the accountant in the field of engineering.

The Engineer's Failure to Appreciate Cost Accounting

That engineers do not fully appreciate the fact that cost accounting is a complex science necessitating specialized knowledge for its application is evidenced by their writings. It was a distinct shock to the author after having spent a number of years of very hard work in developing Mr. Emerson's ideas along accounting lines to find, in re-reading one of his books, the somewhat airy statement that cost accounting can be very simply and easily developed from the cost formula he gives. Another engineering writer even states that "the employment of an expert accountant to devise and install a cost system in a manufacturing and repairing plant is an absurdity." And further that "an expert on shop management can learn the simple accounting required in a short time. In fact he cannot be an expert without this knowledge."

The above quotations are somewhat illuminating as illustrating the tendency for an expert in one line to underrate the knowledge and experience required to qualify as an expert in another. The old proverb "a little knowledge is a dangerous thing" applies to accounting as well as to other things.

That the primary purpose to be aimed at in any system of accounts is extreme simplicity of design is a fallacy that will undoubtedly die hard. A cost accounting system is merely a machine for the production of specialized information and, like any other complicated piece of mechanism, should be judged not so much from the standpoint of simplicity of design as from that of the results obtained from its use and the facility and economy with which it can be operated. To condemn any system of accounting on the sole ground of its complex design would be as absurd as to complain that the modern automobile is far more elaborate in its design than was Trevethick's steam carriage which astounded and alarmed the pedestrian in 1802. Both represent means of transportation, the earlier machine being absurdly simple in design, but no one would claim that it was a superior article to the later invention. Undoubtedly all possible simplicity in design consistent with efficient operation should be aimed at, but the term is a purely relative one and the question is not so much whether a system is simple or not but whether, taking all factors into consideration, it is as little complex as the conditions warrant.

It is believed that the methods which will be submitted later

in the present work will demonstrate that accounting plans must be quite complex in design, though not necessarily difficult in operation, if the multiplicity of results desired are to be obtained with a minimum of expense and without duplication of effort.

The designing of such plans demands a high degree of accounting technique and a fundamental grounding in accounting principles which can only be obtained by years of practical accounting experience which obviously the engineer is not often in a position to obtain.

The Similarity of a System and a Process or Machine

The author has visited a number of plants where extensive reorganization work has been undertaken by efficiency engineers, but in no case which has come to his attention has there been any complete layout of the plan to be followed. A manufacturer, employing the services of an engineer to design a machine to meet some special requirement of his business, would certainly feel entitled to call for complete working drawings of the proposed machine before he approved the spending of possibly several thousand dollars for its construction, particularly so if he were better acquainted with the manufacturing processes involved than the engineer he employed. It would also seem reasonable for a manufacturer, employing the services of efficiency engineers to undertake the introduction of improved methods in his plant, to require similar complete drawings illustrating the results contemplated under the plan and the steps proposed to realize these results. For, though the manufacturer is calling upon outside assistance in the solution of his problems, it is obvious that there must necessarily be many details of the business with which he is better acquainted than the experts he employs, and his careful consideration of the details of a plan before its installation is attempted may often obviate the necessity of changing methods once installed.

The first step toward the solution of any problem is a proper classification of all of the factors entering therein, and the most effective method to use in designing a plan to meet the needs of a complex industrial situation is to clearly show on paper the various elements and interrelationships involved, and then to follow a similar method in formulating and presenting plans to meet the conditions existing. From the standpoint of the engineer engaged in the work of applying scientific manage-

ment principles, and in the introduction of improved routine methods, such a method of procedure presents marked advantages. Not only does it aid in clarifying the problems of the engineer but it also provides for all effort expended being directed toward a clearly defined end and reduces the amount of supervision required. In the event of any change of organization it enables the work to proceed without embarrassment.

In the course of his professional work the author has investigated the cost systems operated in approximately a hundred different factories but he cannot recall one case in which he found that any systematic attempt had been made to diagram the cost methods employed. This is a remarkable fact when it is considered that in some of the factories hundreds of different accounting forms had been introduced piece-meal and haphazardly without any comprehensive general plan, whereas the superintendents of these plants would not think for even a moment of constructing a one-car garage without first having complete detailed drawings submitted to them.

One marked disadvantage of not having complete plans for a cost system before the attempt is made to install it is the necessity which arises as a result of this negligence for the perpetual changing of forms. The author recalls one instance where a professional accountant changed a time card three times in one month. Employees soon lose confidence in a system which is always being changed and they very naturally reach the conclusion that the designers of the system do not really know what they want the result being that the work of introducing the system is rendered more difficult than necessary.

Owing to the almost invariable custom of introducing cost methods without first making comprehensive drawings showing the ultimate results to be accomplished and every intermediate step involved in obtaining these results there is no very clear idea in the minds of those introducing the cost methods as to exactly what results they are endeavoring to accomplish, with the result that the systems start out ambitiously enough with elaborate detailed forms but get nowhere and in fact are remarkably like the western roads referred to by Ralph Waldo Emerson which "opened stately enough with planted trees on either side, to tempt the traveler, but soon became narrower and narrower, and ended in a squirrel track, and ran up a tree."

In Figure 1 is produced a section of a drawing illustrating this idea of showing the operation of a plan in considerable detail and in diagram form.

The Reasonable Requirements of a Cost System

Though it is obviously somewhat difficult to submit any definite standards for cost accounting methods generally, as these will greatly depend upon the character of the business and to some degree upon the ability of the organization and the extent to which it can make good use of the information which would be obtained, certain more or less general requirements can be stated.

As an illustration of the extended scope of a properly designed cost system, the following list is given of demands which should reasonably be made of such a system for a concern manufacturing a varied line of metal parts, some standard and some special, the manufacture of which involves the use of a considerable variety of machines.

1 Accurate Cost of Specific Articles
2 Manufacturing Efficiency Data
3 Promptness in Furnishing Information
4 Reports for the Executive
5 Sales Statistics
6 Cost of Operating the System
7 Standard Practice Instructions

1 Accurate Cost of Specific Articles

The system should provide for the tabulation of cost data in such form that accurate and prompt information can be obtained as to costs by operations and in total of parts, part-assemblies and final assemblies. Not only should the system furnish information as to costs actually realized but, more important still, it should provide prompt and accurate data as to what costs should be under current conditions. In fact, in the business of to-day a cost system that does not provide for a predetermination of costs cannot be regarded as in any way meeting requirements. In many cases an article is placed on the market before it has been manufactured in sufficient quantities to render the detailed actual cost data obtained a reliable guide as to what the cost should be in manufacturing on a commercial scale and, unless some reliable method of predetermining costs is followed, fixed the sales price of the article is largely a matter of an intelligent guess.

The need for a means of properly predetermining costs is felt by most manufacturers but such work as is done along these lines is generally undertaken independently of the regular cost system and not being subject to the checks and balances provided by a correctly designed cost system these estimated costs are often seriously incorrect. The author recalls one instance where a predetermined cost of a tractor had been made which on investigation was found to have omitted the cost of the wheels!

The feasibility and importance of predetermining costs has been enlarged upon by several writers on cost accounting, but as far as the author knows there is no book on cost accounting which illustrates how a cost system can be designed so that this function of cost predetermination will form an integral part of the general plan.

The importance of cost predetermination is emphasized by Benjamin A. Franklin, who in his stimulating and interesting book "Cost Reports for Executives" writes as follows:

> This variation of the cost of the same article at different times constitutes the important point, not only in the proper understanding, but in the appreciation of costs. The ability to master this point and to figure estimates or prediction of cost from a standard under varying conditions gauges the comprehension or the meaning and value of practical costs.

Another writer who has dealt with the cost predetermination function of a cost system is William B. M. Ferguson, who in "Estimating the Cost of Work" makes the following remarks:

> In the art of estimating, it is only in determining what costs should be, if we eliminate preventable waste (or using Mr. Emerson's term, it is only in predetermining costs) that we establish a standard which is "a criterion of excellence." In estimating what costs will actually be we use for a standard of comparison the type or example of past performance which represents the average cost of work, under standard conditions. By thus using a standard estimate for each unit (whether the unit chosen be an object or operation), based on the cost of a standard number of units under certain conditions taken as standards the estimator can proceed methodically to classify and study all cost data and estimates with reference to such standards.

In concerns manufacturing a standard product, no matter how complicated, a system of cost accounting if properly designed should enable accurate information of the current costs of manufacture to be obtained very promptly. For instance, in a business such as the manufacture of agricultural implements, where many different kinds of machines are manufactured, it should

be possible for the cost accountant to furnish an approximately accurate cost of any machine under current conditions in less than half an hour after the information is called for, and this should be so even if the machine in question comprises several hundred parts and necessitates the performance of five times as many operations.

2 Manufacturing Efficiency Data

Cost of Idleness. No system of cost accounting can be considered as in any way suitable to meet the needs of the manufacturer which does not distinguish between the cost of production and the cost of idleness. Under the usual methods it is necessary to distribute the total expenditures for the month over the total product for the month regardless of whether the factory is operating at full capacity or not with the result that the effect of what is probably the most important single cost factor, namely that of idleness, is merged in the general costs.

Every manufacturer knows that when operating at less than full capacity his costs will increase owing to certain of his expense remaining whether he operates at full capacity or not but there is all the difference in the world between knowing this fact in a general way and having cost statements showing monthly the total amount costs have been increased owing to the failure of the factory to realize its full production possibilities.

Variations in fixed charges owing to the production being less than 100 per cent of capacity should be analyzed as due to:

(*a*) Actual idleness of the department or the plant as a whole
(*b*) Shortage of operators
(*c*) The average production per operator being less than standard

Labor. The cost system should furnish complete data relative to manufacturing efficiencies and in particular information regarding the efficiency of:

(*a*) The individual operator daily, weekly or at longer periods
(*b*) A class of workers
(*c*) A department
(*d*) A plant as a whole

Furthermore, increases or decreases in cost should be analyzed into those resulting from changes in:

(*a*) The rate of wages paid
(*b*) The time consumed in the performance of manufacturing operations.

Material. The system should provide for showing daily, weekly or monthly, as desired, increases or decreases in cost resulting from variations in:

(*a*) The purchase price of material
(*b*) The efficiency of the use of material, this being analyzed as to: individual operators, classes of operators, a department and a plant as a whole.

Manufacturing Expenses. The increases or decreases in cost resulting from variations in expense should be shown in the completest form, and in particular the following information should be provided:

Handling and Transporting Expense. Increases or decreases in cost should be shown for the various main classes of material and for miscellaneous stores and supplies.

Power. Records should show increases or decreases in power cost analyzed as to those resulting from variations in:

(*a*) The cost of power.
(*b*) The efficiency of use of power.

In the former case cost fluctuations should be analyzed as to cost of coal, unloading and handling, power purchased, labor, repairs and supplies.

Miscellaneous Stores and Supplies. Increases or decreases in cost should be shown divided by departments, and, if desired, by individual operators. These increases or decreases should be analyzed as to those resulting from variations in:

(*a*) The purchase price of supplies
(*b*) The efficiency of use of supplies

Tool Costs. Information should be provided showing the daily, weekly or monthly variations in the cost of tools divided as to:

(*a*) Classes of machines, or individual machines when desired
(*b*) Departments
(*c*) A plant as a whole

In addition, such variations should be analyzed to show increases or decreases resulting from fluctuations in the purchase price of tools or in the cost of making them, and variations in the efficiency of the use of tools.

Machine Costs. Very complete information should be provided as to machine efficiencies, this showing increases or decreases in cost resulting from variations in:

(*a*) The number of hours a machine is operating
(*b*) The production efficiency of the machine when operating
(*c*) The cost of maintaining and operating the machine

Spoilt Work. Increases or decreases in cost resulting from fluctuations in the loss from spoilt work should be shown daily, weekly or monthly divided as to: individual operators, classes of operators, classes of product, departments and a plant as a whole.

Miscellaneous Works Expense. Full information should be provided as to increases or decreases in costs resulting from variations in actual expense, compared with standard, these data being arranged under the account classification most suitable for the business.

3 Promptness in Furnishing Information

The value of information relative to the cost of manufacturing operations is generally in direct ratio to the promptness with which such information is furnished. Though it is not usually feasible to provide complete statements covering all of the operations of the business at very short intervals, owing to the expense which would be involved, at the same time there are certain very necessary reports which should be furnished to the shop executive every day.

The following is indicative of the character of the information which should be provided daily:

Summarized Manufacturing Report:

Goods ordered, manufactured and shipped to-day and to date, divided as to classes and by any further sub-division desired.

Summarized Payroll Report by Departments:

Number of employees on roll.
Number of employees absent or working short hours and total hours so lost.
Actual hours worked by operators.
Standard hours of work produced by operators.
Percentage of efficiency realized.
Payroll of operators.
Average rate per hour of operators.
Hours worked other than by operators.
Payroll of employees other than operators.
Average rate per hour of such employees.
Total hours worked by all employees.
Average rate per hour earned by all employees.

Summarized Machine Report for Each Machine and Class of Machine:

Standard hours.
Actual hours worked.
Employment efficiency.
Standard production.
Actual production.
Operating efficiency.
End efficiency.

In addition to providing for information being furnished daily to the shop executive in the form of summarized reports as described above, provision should be made in the design of the cost system for all data relative to costs and operations being so compiled as to render it possible at any time to obtain very promptly any arrangement of such data required.

Owing to the very considerable amount of clerical work involved in the compilation of complete cost statements covering all of the activities of a factory it has become an almost universal custom for these statements to be prepared monthly, the number of days elapsing between the end of the month and the issuing of these statements varying from five days to a month or more. Even under the best conditions, however, it will be obvious that some of the information presented in these statements must be

in regard to events which are over a month old and by the time the cost statements have been examined sufficiently to enable the superintendent to determine where conditions appear to be unsatisfactory the time which has elapsed between the event and the investigation will often render the latter of little value.

Complete information relative to costs cannot in the nature of things be economically presented to the operating executive daily, but much of the information incorporated in the monthly statements, and in fact most of the really essential information can and should be made up weekly and in view of the fact that payrolls are generally made up on a weekly basis it would seem obvious that as regards labor costs at least it is the logical procedure to furnish the superintendent with complete information relative to this class of expense and not to hold up information which can be so readily obtained until the end of the month because it is not feasible to make burden distributions until that time.

4 Reports for the Executive

It is by no means unusual for the executive of a large manufacturing company to be presented at the close of the month with cost statements in such voluminous form as to render these a substantial volume and the amount of time which the conscientious executive is compelled to devote to the study of such statements is a serious form of avoidable industrial waste. The idea that an executive should be compelled to wade through dozens of detailed statements involving hundreds and often thousands of figures is an absurdity which it would seem would be self-evident but the condition is so general that the average executive apparently accepts the situation as being an inevitable one. As a matter of fact it is perfectly possible to furnish the executive of a large manufacturing plant with a summarized cost statement on a single sheet of paper of ordinary letter size from which in a few minutes he can learn more about the essential facts of his business than would be possible from spending hours in grappling with the usual detailed cost statements.

Monthly cost statements in general are confined to a tabulation of expenditures which are shown without relation to standards so that the executive is compelled to rely for his information as to the trend of costs on making comparisons

of the cost of each item of expense for this month with that for the month previous and so on, a laborious and everlasting procedure which consumes a great deal of time and produces little results.

George Horace Lorimer in his "More Letters from a Self-Made Merchant to his Son" strikes the keynote of the conservation of the time of executives when he writes:

> In the first place, you don't need to bother very much about the things that are going all right, except to try to make them go a little better; but you want to spend your time smelling out the things that are going all wrong and laboring with them till you've persuaded them to lead a better life. For this reason, one of the most important duties of your job is to keep track of everything that's out of the usual. If anything unusually good happens, there's an unusually good man behind it, and he ought to be earmarked for promotion; and if anything unusually bad happens, there's apt to be an unusually bad man behind that, and he's a candidate for a job with another house.

In the above quotation George Horace Lorimer is describing the application in industrial life of the "principle of exceptions" that is, the concentration of attention to the abnormal and unfavorable condition and the spending of no more time on the normal than is necessary to establish the fact of its being normal. If it is desired to eliminate the shocking loss of time of industrial leaders due to the lack of focus in the accounting statements with which they are furnished it is necessary that this principle of exceptions he applied to cost accounting methods and this involves firstly the comparisons of all expenses with standards and secondly the analysis of variations from standard as to the causes underlying such variations.

The summarized cost statement which should be furnished the executive of a manufacturing company should not require more than fifty figures at the most to furnish him with a view in proper perspective of the trend of his manufacturing costs and the following taken from an actual form used by the author clearly illustrates the principles involved:

SUMMARIZED MANUFACTURING STATEMENT MONTH OF

Total Actual Cost for Month.....	$000.00
Total Standard Cost for Month.....	$000.00
Net Increase or Decrease Comparing Actual with Standard*.....	$000.00

*Increases always shown in red and Decreases in black.

ANALYSIS OF ABOVE VARIATION BY CAUSES

Variations in Fixed Charges Due to Fluctuations in Production Caused By:		
1 Calendar variations	$000.00	
2 Idle time	$000.00	
3 Variation in number of operators	$000.00	
4 Variations in efficiency of operators	$000.00	$000.00
Variations in Direct Labor Costs Due To:		
1 Rates	$000.00	
2 Efficiency of operators	$000.00	$000.00
Variations in Indirect Labor Costs Due To:		
1 Rates	$000.00	
2 Hours	$000.00	
3 Extra pay for overtime	$000.00	$000.00
Variations in Back-Work Labor Costs Due To:		
1 Rates	$000.00	
2 Hours	$000.00	$000.00
Variations in Stores and Supplies Due To:		
1 Price	$000.00	
2 Consumption	$000.00	$000.00
Variations in Power Cost Due To:		
1 Cost of producing power	$000.00	
2 Efficiency of use of power	$000.00	$000.00
Variations in Salaries Due To:		
1 Rates	$000.00	
2 Number of salaried persons employed	$000.00	$000.00
Variation in Miscellaneous Expense		$000.00
Net Increase or Decrease as above		$000.00

Supporting the summarized statement should be detailed statements providing the executive with the fullest details as to the inefficiencies disclosed in total on the statement. For instance, if an increase in the salary expense attracts his attention he should be able to turn instantly to a detailed statement which will show him exactly in which departments and positions such increase occurred. The essential idea underlying reports to executives should be the presentation of statements in such form that the unfavorable condition stands out prominently on the

summarized statement (for this reason cost increases under the author's methods are invariably shown in red ink) and the time is rapidly approaching when no executive worthy of the name will be satisfied to spend time in analyzing detailed cost statements in an effort to locate essential information which under a properly designed system should automatically and unmistakably be drawn to his attention.

The system should of course show monthly the net profit realized from operations, gross profits being shown as to lines, specific articles, or under such classification as is best suited to meet the needs of the particular business. Furthermore, the statements should clearly indicate the extent to which fluctuations in profits have resulted from variations in the prices realized for the product and from variations in the cost of manufacture.

5 Sales Statistics

The system should be designed to enable any reasonable refinement of selling efficiency data to be obtained. In particular, information should be provided showing the profits realized:

(*a*) By salesmen
(*b*) On different lines
(*c*) By territories
(*d*) By different classes of customers

In addition, it should be possible to obtain expeditiously any combination of the above information, as for instance profits realized by salesmen on each line, or profits realized on different lines by territories, etc.

In addition to providing for very complete data relative to profits and losses realized from actual deliveries to customers, the system should render it possible to obtain at least approximately correct information relative to the profits which should be realized on orders accepted but not filled. The predetermination of profits is a corollary to the predetermination of costs and though figures as to the former will be accepted by the wise executive with due reservation, properly used they should prove of the greatest assistance in his direction of the policies of the business. Furthermore, with a properly designed system the executive is furnished each month with full information as to where the actual results have varied from the estimates,

and as to the causes for such variations, so that he is enabled to adjust his plans to conform to fluctuating conditions. Whereas in the past executives were satisfied with receiving annual statements of profit and loss, and in the present are in many cases content to obtain monthly information as to profit actually realized, in the near future they will demand the predetermination in large measure of costs and profits. In place of working to a more or less nebulous end, each member of the organization will have definite standards to strive for, the extent to which such standards have been realized being reflected in the cost accounts and in the reports to the executive.

Business men are gradually emerging from the retrospective to the prospective attitude and in the author's opinion, the accountant of the future will spend more time in making intelligent forecasts than in recording past events.

6 Cost of Operating the System

The cost system should be economical as regards:

(*a*) Executives, whose time in many organizations is wasted to an appalling degree in the endeavor to extract vital information from the mass of undigested cost data presented to them

(*b*) Clerks

(*c*) Shop employees, in particular as regards time spent in making out detailed time distributions, weighing material, etc.

The importance of a system of cost accounting being designed with a view to conserving the time of executives has already been dealt with in preceding paragraphs. For a system to be economical as regards the number of clerks necessary to carry it along depends in large measure upon the judgment, ingenuity, and experience possessed by its designer and in this connection it may be mentioned that many manufacturers adopt a penny-wise and pound-foolish policy in entrusting the design of their cost systems to the men they expect to operate them afterwards. Such a policy is equivalent to expecting the designer of a steam engine to spend the balance of his life operating it, for it would seem to be obvious, if the matter is given any consideration, that an accountant possessing the imagination, training, and

ability to successfully design cost accounting plans to meet complex conditions and to get the desired results with minimum operating expense will not generally be open to a proposition to abandon the fascinating sphere of design for the useful but certainly less stimulating field of routine cost work.

An important point to be considered in the drawing up of cost accounting plans is the proper coördination of the work of the cost department with that of the production and planning department, and in later chapters illustrations are given of coördinated cost, planning and production systems where this important requirement is given full consideration.

Systems of cost accounting which demand the keeping by or for each workman of a record of the time spent on each standardized operation he performs during the day result in the waste of a great deal of time of producers and in idleness of equipment in order to compile data which in the majority of cases are of exceedingly limited value. The author has seen operators working on as many as twenty to thirty short-time operations in a day being compelled to walk fifty feet or more to a time clock every time they finished a job, and to this wasted time should be added that spent by the cost clerks in making minute distributions and postings of time to detailed cost-of-part cards to which reference was hardly ever made. There may be situations where it is necessary to figure the elapsed time on every job a workman does, but if there are these are the exceptions rather than the rule.

Much unnecessary work is often called for in the operation of a cost system owing to the performance of needless weighing operations. Such superfluous work not only involves the direct expense of weighing but also the indirect loss resulting from the slowing up of manufacturing operations and in the cost of clerical work involved in recording this unnecessary weighing. It is hardly necessary to remark that complete and proper control should be exercised over material but it will often be found that by the exercise of a little intelligent planning just as effective control can be maintained by performing half as many weighing operations as were previously considered necessary.

Very often considerable unnecessary expense is involved in the operation of stores systems particularly those in which stores accounts are carried both in quantities and money values for every item of stock carried. The author recalls one instance where an express bill for fifty cents was distributed over twenty different stores accounts. The case was exceptional, of course,

but there is no doubt that many stores systems cost at least twice as much as they should owing to this lack of a sense of relative values on the part of their designers.

Manufacturers are apt to consider the cost of their cost departments to be confined to the payroll of the cost department but this is practically never the case and the indirect expense resulting from an improperly designed cost system can very easily amount to a serious drain on a business.

7 Standard Practice Instructions

The plan of the system and the details of its operation should be clearly laid down in diagram form so that employees can easily understand the routine involved and the relation of their work to the general scheme. There should be no possibility of things being done wrong owing to the absence of the clearest possible instructions as to the right way in which to do them. Under this head will come the provision for a complete descriptive card of accounts that will leave nothing to the imagination, for this, though a faculty of great value in certain conditions, is distinctly out of place in account distribution.

The author has previously drawn attention to the fact that cost accounting plans suitable to meet the complex conditions presented by the modern large industrial establishment and capable of furnishing the multiplicity of results demanded, with a minimum of expense and without duplication of effort, must necessarily be complex in design but this in itself is not a serious matter provided the systems can be so drawn up as to render their operation comparatively simple. This result can be realized with the assistance of diagrams such as the author uses, numerous illustrations of which appear in this book, and through the aid of the formulas given in later chapters which render it possible for the ordinary grade of office help to perform the most complex cost calculations speedily, accurately, and mechanically.

It is naturally to be expected that the application of the principles of machine design in the field of cost accounting would develop results in the production of cost information similar to those realized from the development of machinery in factory production. In the latter case as the complexity of the machine increased the producing capacity of the lower grades of labor also increased; by the aid of modern automatic machinery a semi-skilled workman now producing better and infinitely more

work than could the skilled workman of an earlier period. In a similar manner the complex accounting structures developed by the author enable a lower grade of office help to produce more and better information than is possible under the simpler but less efficient forms of cost accounting.

Speed and accuracy in cost accounting work can only be obtained by eliminating the personal element in the greatest possible degree by rendering the routine work as nearly mechanical as possible. This principle is not only applicable to cost accounting work—it touches all branches of human effort, for as A. N. Whitehead in his "Introduction to Mathematics" states:

> It is a profoundly erroneous truism, repeated by all copybooks and by eminent people when they are making speeches, that we should cultivate the habit of thinking of what we are doing. The precise opposite is the case. Civilization advances by extending the number of important operations which we can perform without thinking about them. Operations of thought are like cavalry charges in a battle—they are strictly limited in number, they require fresh horses, and must only be made at decisive moments.

The basic underlying defect in systems which are unduly expensive to operate will generally be found to be faulty design and the absence of adequate standard practice instructions. A cost system which everlastingly demands the making of decisions as to how this problem should be met and how that is like a faulty designed machine which is always breaking down and calling for minor adjustments. In the average cost department 95 per cent or more of the time of the chief cost accountant is consumed in supervising the routine work of getting out figures and only 5 per cent in making use of the figures after they have been compiled whereas the situation should be reversed and 95 per cent of his time should be spent in the interpretation of the figures and only 5 per cent in supervising their compilation.

A Typical Plan of Cost Accounting

In considering the more usual cost accounting methods in relation to the above requirements, it is necessary for the sake of clearness to take some specific case as a means of illustration and therefore in Figure 2 are shown the underlying principles of a cost system employed by a concern manufacturing a varied line of standard machinery, many of the parts of which are common to several machines and where accordingly parts are

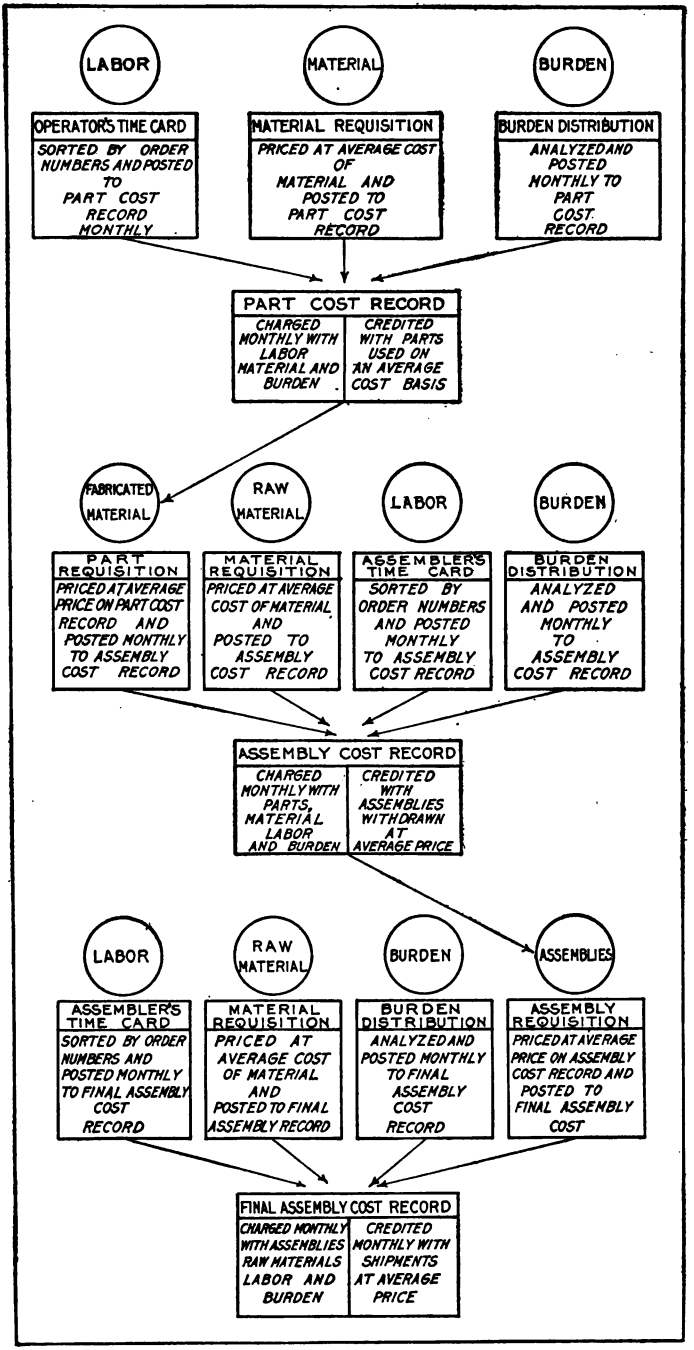

FIG. 2.—Diagram showing essential features of typical old style cost system for standard line of machinery.

manufactured for stock and issued on assembly requisitions, this being a condition common to manufacturers of standardized machinery. It may be mentioned that the plan illustrated is still somewhat generally regarded as an efficient method of cost accounting. In considering this plan no attention is given to questions of burden distribution, etc., but merely to the basic method used in the determination of costs.

Considered from the standpoint of the first of the requirements enumerated above, namely, the obtaining of information relative to the cost of specific articles, it will be seen that under the plan illustrated a detailed account is maintained for the cost of each batch of parts manufactured. To the cost of these parts is charged the actual labor cost of the work performed thereon and the cost of the material used. Burden is distributed monthly to the cost of parts, part assemblies and final assemblies. Parts used in assemblies are charged to the assembly cost card on the basis of the average cost of such parts as shown by the parts' cost card. The cost of the assemblies includes also the cost of assembling material used and assembling labor and burden. The final assembly includes the average cost of part assemblies as shown by the assembly cost cards, assembling labor, material, and burden.

The system now being considered is a typical example of what may be termed historical cost accounting the scope of which is confined to the ascertainment of information relative to costs actually realized. This being the primary purpose of this system, data obtained therefrom as to operating efficiencies being merely incidental, as explained later, the question naturally arises as to what is the value and what are the limitations of cost records compiled after the event.

In a business such as that for which the system being described was designed, it is contended that information relative to past costs is of very limited value. The manufacture of parts being for stock, these parts being withdrawn as required for assembling, it will be understood that it is not only possible but highly probable that the parts included in any machine represent the result of manufacturing operations extending over a considerable period of time, so that the final cost of a machine will represent a conglomeration of data involving material, labor and burden figured at the various prices extending over the period covered by the operations involved in the manufacture of the machine. Such a cost will in itself afford very limited information relative to the current cost of building a machine and with

fluctuating material prices and labor and burden rates a manufacturer would certainly not feel justified in accepting a cost so compiled as the basis for making a selling price. Even if all of the parts required are actually on hand it would seem that the correct basis on which to figure selling prices would be that of replacement cost, not actual cost, for in the event of a falling market purchasers would expect to be given the benefit of the reduced material prices and correspondingly the manufacturer should be entitled to realize the profit resulting from purchasing material before the rise in price.

The whole conception of a cost system which concentrates solely on the obtaining of data relative to past results is unsound and belongs to the days when the manufacturer was satisfied if some time after the end of the year his accountant presented him with a statement showing the annual net profits realized. To be able to operate a business with the maximum degree of safety and profit, before any work is undertaken there should be an intelligent estimate of what its cost will be, this estimate providing a standard of attainment and a definite incentive to economical manufacture.

Under the plan described, in order to obtain reliable information as to current costs it is necessary to refigure the costs already compiled, on the basis of current conditions—a makeshift method for which the system is not adapted and one involving a great expenditure of time and considerable delay.

The Difficulty of Shifting Costs of Labor and Material

A system such as is being discussed may give fairly useful information as to costs during periods of a more or less constant condition of the material and labor markets, but in times of flux, as at present, such a system is liable to prove a danger in giving misleading information, which if accepted as correct may result in serious loss.

Generally speaking, it would appear that this system gives little available cost data except for the purpose of valuing inventories and, even here, it may be questioned whether the costs so obtained should invariably be used for inventory purposes. Public accountants have adopted the principle of valuing raw material in inventories at current market price or actual cost, whichever is the lower, but it will be readily seen how difficult it would be under the plan described to refigure the material

included in work-in-progress and finished machines on a market basis, so that in the majority of cases the auditor, while adjusting the raw material inventory to take care of a fall in the price of raw material, will be inclined to accept the work-in-progress and finished work at their cost as shown on the records, owing to the difficulty of ascertaining the difference between the actual cost of the material included therein and the market value thereof.

Considered from the standpoint of the second reasonable requirement of a cost system, namely, the furnishing of complete data relative to manufacturing efficiencies, it must be admitted that the plan described fails totally to meet the demands. Hardly any other result could be expected when it is considered that the plan concentrates almost exclusively on obtaining *costs* and ignores the equally if not more important question of *causes.*

The cost accounting methods generally followed are directed to a single purpose. As C. U. Carpenter states: "The possibility of ascertaining the cost of an article is often the only thought in the manufacturer's mind when the Cost System is mentioned, and is accordingly the only function that is developed."

The Effort to Trace Causes of Cost Increases

In a business such as has been described, a certain machine or batch of machines completed this month may show an increase in cost as compared with a previous batch, and the manufacturing executive will call for information as to the cause underlying this increase. This will result in an interminable and unsatisfactory investigation—comparisons of the costs of the individual parts will be made—this part is charged to this machine at five cents more than the previous charge. Why? In any one part increases or decreases may be due to the combination of a number of causes. For instance, in the month when the part was made the forge shop was not very busy so the burden rate of that department was increased. Or the work was done on a machine not suited to it, owing to the regular machine not being available. The machine used was more expensive to operate than the regular machine. Or again there was a heavy spoilage on that batch of parts owing to an incompetent operator or due to a defect in the material.

The investigation of the increased cost of the machine being considered will call for a complete analysis of the costs of all

parts showing increases and it may be readily imagined how impossible it would be to bring to a focus information so obtained as to increases in the cost of several hundred parts and probably five times as many operations. Furthermore, under this plan of only considering increases in costs, serious inefficiencies may be overlooked owing to these being offset by the elimination of previous inefficiencies and consequently the total cost of a part remains approximately the same as before. In addition, it may be urged that comparisons with past costs though having their place and being of value when nothing better is obtainable are of minor importance contrasted with comparisons with standards based upon what the cost should be rather than what it was.

After a few unsatisfactory investigations of this kind an executive will soon lose interest in obtaining efficiency data from an analysis of detailed costs, and the work of the cost department will become more or less perfunctory and resolve itself into the somewhat usual state of affairs where a mass of information is compiled of which little use is made.

It seems strange that this method of comparison should be regarded as being at all adequate to meet modern requirements, but in a recent well-regarded book on cost accounting, discussing the value of a detailed system of cost accounting to show the reason for not making a profit on an order for a machine, we find the following:

> But supposing that after all, it was found that we had not made a profit, but a loss instead. What should be done to discover the reason for this loss?
>
> The need for a comprehensive and detailed system of production orders, enabling us to ascertain the cost of each part or component of the machine would be forced upon us. And probably we should not be satisfied even with this. We should also require to know the separate cost of each process or operation on each dissimilar piece. Thus, if the baseplate were in question we should want to know the cost of the metal contained in it, the cost of molding, the total foundry cost; the cost of planing, drilling and hole slotting and scraping the sides, and whatever other operations were performed on the baseplate separately. *Only by doing so, and by being in a position to contrast such detail costs with the costs of similar pieces done on a previous occasion could we conduct our business intelligently and safely.*

It should be noted that the author quoted assumes that the above investigation and cost comparison will be undertaken after it is discovered that a machine has been sold at a loss when it should have realized a profit. There are those who may question

the value of such post mortems, especially when it is remembered that in many factories hundreds of different parts, involving thousands of separate operations, may be worked on in a month.

Some information as to efficiencies is demanded by every progressive works manager, so the method of obtaining efficiency data by analyzing detailed costs proving ineffective, there soon develops a subsidiary system from which statements are prepared comparing the results obtained with more or less arbitrary standards. Among these we may mention our old friend the ratio of so-called non-productive labor to productive labor, which when used as a standard, results in every foreman scheming to include all labor under the head of productive, regardless of its real character.

The Fallacy of Low Non-Productive Labor Percentage

This brings to mind a case which came to the attention of the author where one factory was for years held up as an example to the rest of the factories operated by the same company because of its low percentage of non-productive labor. An investigation, however, disclosed the fact that in this particular factory all employees working in the shop, including the foremen, were reported as productive labor, whereas in the other factories foremen were reported as non-productive labor. A curious feature of such a method of comparison is that it entirely ignores the actual efficiency of operators so that all that is required to enable a foreman to make a most excellent showing, according to this standard, is to increase the productive payroll without increasing the production. In an actual case a foreman introduced an improvement in a machine which resulted in one man being able to do the work which formerly required two. The natural result in the month when this improvement went into effect was an increase in the ratio of non-productive labor to productive, for while the non-productive payroll remained constant the productive labor was reduced and as a consequence the foreman in question was sent for and solemnly reprimanded for his poor showing!

Another favorite fetish of works managers is the ratio of piece work to day work. Where this false ideal is most consistently regarded it will be found that practically all jobs are piece work, and many cases have come to the attention of the author where the foreman did not have the remotest idea of

the time a job should take and issued it to a workman on an hourly rate basis. After the completion of the work he would divide the man's earnings by the production, reporting the result as the piece-work rate and the man's earnings as piece work instead of day work.

The Injustice of Per Pound or Per Piece Factors

A very usual form of presenting efficiency data is to show the departmental cost per pound or per piece of the product manufactured, whereas in many cases the variations in size and complexity of work cause legitimate fluctuations in cost amounting to five times as much as any possible variation in efficiency. Statements prepared on this basis are more often a source of irritation than a spur to efficiency. A foreman is sent for around about the end of the month and told that in the previous month his labor or tool expense per pound or per piece was so many per cent over the month previous. He immediately begins to rack his brain for some reason why this condition arose and probably remembers some particular order which gave him trouble and hopefully advances this as a reason for the poor showing. Of course, the cost system does not provide any specific information as to the causes underlying variations in costs so that the argument is more or less ineffective and the foreman leaves the cost department with a poor opinion of the cost system and with little faith in any information emanating therefrom.

The author was partly responsible many years ago for the introduction of a system under which foremen were paid a bonus based upon the decreases in costs per pound or per piece in their departments. Undoubtedly, this plan had a good moral effect but the author now blushes to think how the system must often have rewarded the inefficient and penalized the competent. Primarily it was wrong, for it based its rewards on comparisons with results previously attained so that the worst organized department where savings could most easily be effected was the one where the greatest rewards were possible. In fact, given a department 100 per cent efficient at the start it would be theoretically impossible under this plan for any bonus to be earned at all. Again, any change in the character of work done in the department might quite easily result in legitimate cost variations per pound or per piece many times offsetting any

possible variations resulting from fluctuations in efficiency. Furthermore, no distinction was made in the case of such items as stores or tools between increases and decreases in cost resulting from variations in the price paid for stores and tools and those which were due to fluctuations in the efficiency of their use. Under this plan it would have been perfectly possible for a foreman to have earned a bonus because of a tool saving in his department, whereas more than the total of such saving might have represented a decreased cost resulting from a reduction in the price of tool steel, the actual consumption of tools per unit of product having increased.

The method described of showing information as to the cost of operating the departments of a factory in relation to standards is, of course, based on a perfectly correct idea, and the absurdities referred to were only due to the absence of proper standards and of an adequate accounting mechanism for providing comparisons of actual costs therewith. The almost universal attempts which are made to supplement the information produced by the detailed cost accounting methods are, in fact, excellent proof that the average works manager realizes the shortcomings of the detailed cost system in force and appreciates the fact that unless costs are shown in relation to some standard they are of little value as a means of increasing the efficiency of a factory.

A criticism which is commonly made of the average cost system is the delay which is experienced in furnishing information to those for whose benefit it is compiled. Promptness in furnishing information is the third of the reasonable requirements of a cost system, and in the system which is being criticized it would be difficult to provide data as to costs until some time after the close of the month, as it is inevitable under the plan employed for the bulk of the cost accounting work to be concentrated in the period immediately following the end of the month. The more promptly a system discloses inefficiencies the more quickly can the unfavorable conditions be corrected, and unless a system provides for daily reports covering the more important phases of the manufacturing operations it can hardly be considered suitable to meet modern requirements.

The Inelastic Methods of Compiling Information

A fundamental defect of most cost accounting systems is the inelastic method employed in compiling information.

Original data are tabulated in such a manner that any rearrangement to meet any other need than the specific one for which the tabulation was made necessitates a complete, laborious retabulation by hand of the original data. By the employment of modern accounting machinery in conjunction with a plan scientifically drawn up to take advantage of the opportunities afforded thereby it is possible to arrange for any combination of original data to be obtained promptly, accurately and at little expense.

The Defect of Lack of Focus

An outstanding defect of the system being discussed and in fact of practically all detailed cost systems is in relation to the fourth requirement enumerated, namely, the necessity of a system of cost accounting being so designed as to render it possible to bring cost information to a focus for the benefit of the manufacturing executive. From the comments already made on the particular plan described it will be evident that under such a method it would not be possible to compile a comprehensive statement which in a few figures would provide the executive with a bird's-eye view of the salient features of the month's manufacturing operations. Executives who endeavor to make use of the information prepared for them by their cost department are engaged in a constant struggle to extract the essential facts necessary for their guidance in the operation of the business from the mass of detailed data presented to them, and it is hardly strange that they sometimes wonder whether the time and money expended in maintaining a cost department is really worth while.

Reports to executives should be based on the principle of exceptions and in place of providing a mass of detailed and undigested information should be drawn up to indicate clearly and unmistakably where exceptional or abnormal conditions exist. The manufacturing executive should primarily be interested in information showing the trend of efficiencies and the reasons underlying fluctuations therein. An exactly opposite ideal is aimed at by the recognized detailed cost system for the basic purpose underlying this plan is to merge all expenses as far as possible into the detailed costs, so that the more nearly such a plan reaches its logical conclusion and the more complete and elaborate the methods of distribution the more inextricably

are inefficiencies buried in the detailed costs. In many manufacturing concerns a serious cause of loss is due to spoilt work and the total loss from this cause is certainly information required by the manufacturing executive, but the author has examined numerous detailed cost systems where such losses only showed on the cost records as affecting the cost per piece of the parts spoiled.

The Importance of Sales Statistics

When its importance is considered, it is a matter of surprise that so little attention relatively has been given to the question of sales statistics, the fifth caption in the list of requirements of a cost system. It is true that a great deal of data is compiled in many institutions covering some phases of the activities of the selling organization and there are in fact few concerns of any size that do not possess records showing the gross sales made by each salesman and in each territory. It is rarely, however, that reliable information is obtained as to the actual net profits earned by a salesman except in those cases where the product is a simple one and the figuring of the profits correspondingly easy. The direct result of this lack of information is that even salesmen who are not paid on commission strive more toward obtaining a large volume of sales than the realization of net profits.

In a business handling a varied and complex product it is not feasible, of course, to obtain the somewhat extensive line of information specified in the list of requirements unless the system of cost accounting has been skillfully designed with this object in mind, and original data are compiled in such form as to render it possible by the use of accounting machinery to obtain expeditiously and inexpensively any combination of information required.

The actual money expended in maintaining any cost system has little significance unless considered in relation to the results obtained from the operation of the system. When both factors of actual outlay and benefits received are taken into account it will be found that the average cost system is unduly expensive. Not only is the actual cost considerable but the results obtained are of limited value. A detailed system of cost accounting such as has been described involves a great amount of clerical work not only in the cost department

but on the part of the workmen making out detailed time reports. In connection with the latter, as will be explained later, it is often possible to eliminate a great proportion of the clerical work performed in the shops and at the same time very much increase the utility of the information obtained.

The relatively high cost of the average detailed cost system is largely due to the immense volume of comparatively useless information which is compiled and also to defects in the design of the system, for as previously stated a common fault of many cost systems is that basic information is tabulated in such a manner as to render it necessary to retabulate this by hand before any rearrangement of these data can be obtained.

The Lack of Coördination

Another cause of unnecessary expense in the operation of a system of cost accounting is the lack of coördination between departments closely allied. This applies particularly to the relations between the cost and production departments which generally operate independently in the use of the same basic information and where there is often found to be considerable duplication of effort. As will be demonstrated in later chapters the work of these two departments is so closely related that it should be considered as a single proposition and the two departments combined. There are few organizations where some loss is not experienced as a result of a lack of proper coördination between departments which should logically be intimately connected. An extreme instance of this kind was a case which came to the attention of the author where the general accounting and cost accounting departments of a large business were so far divorced from one another that each of these departments issued entirely distinct cards of account, this necessitating the analyzing of all shop expenses twice, once for the general books and once for the cost records.

As regards the cost of obtaining the very complete line of information detailed in the list of reasonable requirements of a cost system previously given, it may be stated that in the majority of cases it is perfectly possible to operate a system under which these results can be obtained at an expense no greater, and probably less than, that required to maintain the recognized detailed cost systems. In some cases the author has been enabled to obtain the results desired at a very great saving

over the expense previously incurred, but in any event it may be stated that the expense involved in operating an accounting plan properly designed to apply the principles of scientific management is comparatively small considered in relation to the scope and value of the information obtained.

Dealing with the last of the requirements enumerated, namely, the importance of complete standard practice instructions covering the operation of a system of cost accounting, it has been found by the author that even in large undertakings there is a lamentable lack of such instructions. In fact, it is only occasionally that a case is found where the methods employed have been seriously and systematically analyzed and studied with a view to eliminating duplication of work and improving the methods generally.

The lack of comprehensive instructions and detailed plans covering the operation of a system in its entirety is a source of considerable weakness to the average organization. This condition renders a business entirely too dependent upon the specialized knowledge of individuals and further holds back the development of the junior members of the organization by limiting their horizon to the performance of their specific duties. With complete standard practice instructions, however, not only is the danger of having work done incorrectly owing to the absence of definite written instructions eliminated, but furthermore, when the plan of a system in its entirety is properly presented each member of the organization is assisted in seeing his particular work in its correct perspective. To an ambitious employee diagrams illustrating the routine work of the organization can be of great value—not only do they render it possible for him to perform his immediate duties with a more intelligent understanding of their significance, but they also enable him to study the work of other members of the organization so that when the day of opportunity comes he is ready to take advantage of it.

The importance of standard practice instructions is being increasingly recognized in the field of shop practice, but in the sphere of cost accounting this and other principles of scientific management have been in a large measure neglected. In the author's opinion, however, the day is fast approaching when as much attention will be given to the application of these principles in the cost department as in the shop.

Chapter II

STANDARDS AND STANDARD COSTS

THE use of standards by the human race dates back to the early dawn of civilization. The sparks made by a stone-age savage in chipping a flint arrowhead falling upon some dry grass and setting fire to it resulted in the adoption of a standard method of producing fire, which was very little changed until the lucifer match was substituted for the flint and tinder of our forefathers' time. The savage who tiring of the effort involved in killing fish by means of a spear and who using guile in place of force took advantage of the greediness of his prey and made a primitive hook by lashing a piece of curved shell with fibre to a piece of bone or wood, introduced a standard method of catching fish, the principle of which is identical to that followed by the modern angler.

The forward march of civilization has only been rendered possible by the adoption of standards. Standards passed on from father to son and from generation to generation represent the ratchets on the wheels of progress, and have enabled each forward step painfully and slowly made, to be maintained. Without the privilege of drawing on the accumulated experience of the race as represented by its standards, each individual would be compelled to start at the beginning and progress would have been impossible.

Whereas the savage had very few and simple standards, as civilization developed standards increased in tremendous degree both as regards number and complexity, and in modern life the standards covering the multitudinous activities of human kind are of incalculable number.

In dealing with the subject of cost accounting we are interested only in standards so far as they concern industrial life and here at the outset we are confronted with the fact that it is possible to have many standard ways of doing the same thing. Until recent years the standards followed by the various trades were largely rule-of-thumb or traditional knowledge and as Mr. Taylor stated in "The Principles of Scientific

Management" "Instead of having only one way which is generally accepted as a standard, there are in daily use, say, fifty or a hundred different ways of doing each element of the work."

False Ideals and Standards

In the management end of industry we also find a variety of standards or ideals, many of which are wholly false or at most only partly true. In some concerns the main standard appears to be a large tonnage and where this idea is most rampant, time and time again it will be found that at the close of the month light but highly profitable work will be relentlessly side-tracked, no matter how urgently required by the customer, in order to manufacture some relatively unprofitable but heavy material for which there is no immediate demand but which will enable the month's tonnage production to appear in a favorable light to the directors. We are all familiar with the wild scramble in many shipping rooms at the close of the month to get out as many goods as possible in order to swell the month's shipments and it would be difficult to estimate the number of mistakes which are a result of this somewhat misguided enthusiasm, due to the setting up of a false or at least an inadequate ideal or standard.

Reference has previously been made to other false ideals or standards common to manufacturing institutions, such as attempting to realize as high a percentage as possible of piece work, or of so-called productive labor, but while such standards are to some extent founded upon knowledge gained from practical experience they present a dangerous tendency to grasp at the shadow and lose the substance. This is particularly so as regards the introduction of piecework rates on a large scale without proper consideration.

The fundamental idea underlying scientific management is the substitution of definite, scientifically determined standards for all these nebulous ideals, and clearly defined methods of reaching these standards instead of haphazard and rule-of-thumb methods. This obviously applies to all phases of scientific management such as time and motion study, standard practice instructions and planning and dispatching methods.

It is the province of the engineer to determine the standards for use in the shops and to provide for proper methods to be adopted for the realization of these standards.

In view of the complexity and number of standards employed, it is obvious that some means must be provided for showing the extent to which the results actually obtained conform to the standards set up, and this demands the maintenance of records. It is the province of the accountant to provide and carry along such records.

The Division of Responsibilities of Operating and Accounting Divisions

It would seem well at this point to emphasize the importance of a correct division between the responsibilities of the operating and cost divisions as regards the design and operation of the cost system, for there is probably no problem of organization concerning which such varied views are held as this. Some accountants take the extreme view that the factory organization should have nothing to say as regards the cost system and should be absolutely dependent upon the judgment of the cost accountant as to the extent and character of the cost information to be furnished the factory. On the other hand there are factory executives who regard the compilation of cost information as being purely a shop proposition and who operate cost systems which are entirely independent of the general accounting system. It would not be difficult to prove that the standpoint of each of these classes of extremists is an incorrect one—there can be no justification for the attitude of those accountants who regard the cost system as being merely an appendage of the financial department and it is this restricted viewpoint of many accountants which has done more to discredit cost methods generally in the shops than probably any other factor and has called forth such criticisms as the following made by the late Mr. Gantt when he said:

> Most of the cost systems in use and the theories on which they are based have been devised by accountants for the benefit of financiers whose aim has been to criticize the factory and make it responsible for the shortcomings of the business. In this they have succeeded admirably—largely because the methods used are not so devised as to enable the superintendent to present his side of the case.

It is doubtless this arbitrary and narrow-minded attitude of many accountants that has caused some factory executives to swing to the other extreme and regard the cost system as coming solely within the province of the operating division. As Mr. Franklin states:

While the accuracy of unit order of article cost may not be absolute, the cost of total product can and should be proved absolute. This can be done only by connecting it with the accounting or bookkeeping methods. . . . Any plant without such connection has clearly not understood the cost problem.

No factory superintendent of real calibre would wish however to be bothered with the responsibility of a cost system if while being relieved of this he could be assured that all reasonable requirements which he might make of the accounting division for information would be satisfactorily met, and accountants have only themselves to thank in most cases for encroachments on their territory. The function of the cost department is purely that of service to the administration, selling, financial, and manufacturing divisions of the business, and no system of cost accounting can be considered as completely meeting the requirements of modern industry unless it meets all reasonable demands of these divisions as regards furnishing prompt, accurate, and comprehensive information as to the operation of the business. Fortunately it is possible to draw a clear and logical line of demarcation between the functions of the operating and accounting divisions in connection with a system of standard cost accounting, their relations to the system and to one another in connection therewith being definable as outlined in the following paragraphs.

The Function of the Operating Division

It is the function of the operating division to set the standards which will be used as the basis of the cost system, to determine for instance the capacity of the different producing departments, to furnish information relative to the standard routings followed by the product, to set time standards for the performance of manufacturing operations, to determine the number of pounds of steam which should be produced from a pound of coal, etc., and in brief to set standards for all manufacturing operations.

It is also the function of the operating division to fully advise the accounting division of its requirements in connection with cost information. The operating division should likewise furnish such reports and information as are necessary for the operation of the system. *It is not however the function of the operating division to design accounting systems or forms independently of the accounting division.*

The Function of the Accounting Division

It is the function of the accounting division to cooperate with the operating division in connection with the compilation of standard data to the extent of furnishing information obtainable from the records of the cost department. It is further the duty of the accounting division to perform such purely clerical work in connection with standards as, for instance, classifying the standard data furnished by the operating division in such form as to meet the requirements of the accounting division. It is furthermore the duty of the accounting division to compile schedules fully covering the information it desires the operating division to furnish.

The actual designing of the cost system and the drawing up of forms and standard practice instructions in connection therewith is solely and absolutely a function of the accounting division and of its professional advisers.

It is the function of the accounting division, as far as is consistent with sound accounting and business principles, to meet the desires of the operating division as regards the character of the cost information to be furnished and the form in which such information is to be presented.

It is the function of the accounting division to maintain complete records covering the cost of all operations—to carry such records both at actual cost and in relation to the standards determined by the operating division, and also to analyze the differences between actual and standard cost by causes and to render periodical statements to the operating division in the form agreed upon and at the times set. For instance, it is the function of the accounting division to advise the operating division as to the extent of an increase in cost owing to less than the standard number of pounds of steam per pound of coal being produced, to an increase in the purchase price of coal or in the time consumed in manufacturing operations—in brief to advise the operating division of all divergences from standard and the cause of such variations as disclosed by the cost records. *It is not, however, the function of the accounting division to set operating standards.*

The above remarks relative to the respective authorities and responsibilities of the accounting and operating divisions do not represent merely arbitrary, personal rulings. The division there made is based upon fundamental principles. To take for in-

stance the statement as regards the designing of cost systems and forms being purely the function of the accounting division. A system of cost accounting is analogous to a machine, in fact, it is a machine for the production of cost information. A machine represents an arrangement of parts coördinated to give the results required with the minimum expenditure of power and loss of friction. Obviously, in the design of a machine the designer must have in mind not only the individual functions of the respective parts but also the relation between these parts and the machine or system as a whole. To attempt to have some parts designed by one individual with a viewpoint largely restricted to the function of these particular parts without reference to the machine as a whole, and other parts designed by some other person similarly situated cannot but result in the system being lacking in coördination and proving less satisfactory in operation than would be the case if the basic principles of designing had been followed. Failure to conform to these principles invariably results in the operating and accounting divisions duplicating information, in unnecessary expense and constant irritation.

The statement that it is not part of the functions of the accounting division to determine standards also calls for little argument in its support. Such standards as the accounting division would be in a position to set must necessarily be largely based upon records of past experiences, and though data as to past performances are of interest and of value in determining the trend of costs, such data are not suitable for use as standards in the sense in which this term is used in this book. The setting of cost standards calls for engineering and operating experience which the accountant per se is not often in a position to obtain, but in any event if he should possess such experience in any degree this is merely incidental and does not bring the setting of standards within the domain of the functions of the accounting division.

In large manufacturing businesses, the author has found that most satisfactory results can be obtained by placing in the cost department a representative of the operating department who forms a link between the accounting and operating divisions and whose main functions are to supervise the compilation of standards and to ensure that cost and efficiency information produced by the cost department is given proper attention by the operating division. He also acts as an interpreter of the cost figures.

The Relation of Standards and Records

Standards and records are as inseparable ideas as latitude and longitude, debit and credit, east and west. Standards without records are as ineffective as firing at a target would be if the marksman had no means of determining whether he was making hits or not, and, vice-versa, records without standards would be equivalent to carefully recording the result of every shot but giving the marksman no definite target at which to aim. With standards and no records we are in the position of a traveller with a time table and no watch, while conversely with records without standards we are in the position he would be with a watch but no time table.

A very common illustration of standards without records is presented by the concerns who issue many rules and instructions but provide no systematic method of ascertaining whether such instructions are followed, with the inevitable result that they are "more honor'd in the breach than the observance," and in the innumerable systems which are operated in a way far different from that originally intended. As Mr. Gantt states:

> Many shops have a very nice schedule system; they plan their work beautifully—at least, it looks very pretty on paper, but they have no means of finding out whether those schedules are lived up to or not. Usually they are not.

The majority of cost accounting systems are representative of records without standards with the result that a great proportion of the information compiled is meaningless and valueless, as the data obtained not being shown in relation to any standard of attainment are largely without significance.

A further illustration of the use of records without standards is that of the man who keeps the most minutely detailed account of his personal expenditures, but has no budget. The result is that having no definite scheme of saving, his accounts do not materially aid him in this connection, but merely provide him with the sad history of where his money went.

Numerous illustrations of standards combined with records present themselves among which may be mentioned: taximeters which show the actual amount earned figured at a standard rate for a certain distance; the time book on which a red line is ruled at the opening hour, all persons signing above the red line being on time and all under late; or the recording time clock

which shows in printed red ink figures all cases of tardy arrivals, or variations from standard. The budget systems of finance when properly carried out are perfect examples of the effectiveness of combining standards and records, the standards being the appropriations made for the various purposes and the records showing the extent to which the actual payments made conform to these standards.

The average office affords an illuminating illustration of operations being performed with neither standards nor records. In many offices those in charge have but the vaguest idea of the volume of work which should be performed in a day and maintain no records showing the work done by individuals, with the result that office help generally is notoriously inefficient. The average office employee adjusts his pace to meet the immediate demands upon him as represented by the work ahead. The author calls to mind a case which came to his experience where in a seasonal business the sales in three months of the year aggregated as much as in the remaining nine months, yet in spite of the very small amount of work requiring to be performed by the bookkeepers during the slack months they appeared just as busy as during the heavy shipping season.

The application of the principles of standards to cost accounting necessitates the predetermination of costs—that nothing should be undertaken without its cost having been calculated in advance. It changes the whole viewpoint of cost accounting from retrospection to prospection.

Can Costs Be Predetermined?

The argument may be advanced that it is not possible to predetermine costs, particularly in jobbing shops and industries manufacturing a non-standardized product, but any doubts that the reader may have in this connection should be dispelled by the testimony of Mr. W. B. Ferguson, who in his valuable book "Estimating the Cost of Work" demonstrates the feasibility of predetermining costs in so difficult a class of work in this respect as that of ship repairing.

In an article appearing in *The Journal of The American Society of Mechanical Engineers* on the relation between production and costs the late Mr. Gantt made the following statement relative to the feasibility of predetermining costs:

> . . . it should be possible for a manufacturer to calculate just what

plant and equipment he ought to have, and what the staff of officers and workmen should be to turn out a given product.

If this can be correctly done, the exact cost of a product can be predicted. Such a problem cannot be solved by an accountant of the usual type, but is primarily a problem for an engineer, whose knowledge of materials and processes is essential for its solution.

Having made an attempt to solve a problem of this type, one of the most important functions we need a cost system to perform is to keep the superintendent continually advised as to how nearly he is realizing the ideal set, and to point out where the shortcomings are.

The strongest objection to this method of cost accounting will probably come from cost accountants lacking the practical experience necessary to estimate the cost of work, but as suggested in the quotation just given it is not the province of the accountant to set up standards, it is primarily that of an engineer or an experienced shop man working in conjunction with the accountant.

Even though there may be cases where sometimes it is difficult to obtain a very accurate estimate of the cost of doing any work it is contended that any estimate carefully made is far better than none at all. It at least gives some incentive to work to. In cases where bids are made for contracts, there is no argument as to the necessity for predetermining costs, and this rule applies in any case where the price is made in advance.

It is of course a well-known fact that the cost-plus method of remunerating contractors was extensively employed by the government in the construction of war camps and war plants. In a recent article in the New York *Tribune* it was stated that this system was adopted "because of the necessity for haste in the construction of war establishments and because of fluctuating cost of materials and labor, which would have made contractors reluctant to assume obligations involving millions of dollars on their own account. . . . By this system the government furnished everything and paid all costs, depending upon the contractor to do the work efficiently and expeditiously and with as much economy as possible."

It would be difficult to conceive of any system more perfectly adapted to defeat the purposes enumerated than the cost-plus plan which in offering a premium for incompetency and waste is obviously fundamentally unsound. That the system would result in appalling waste was inevitable and that it did so is now a matter of history. In this connection the following from the article already mentioned is illuminating:

"Army training camps cost the government $1,200,000,000.

Contractors net profits were about $22,000,000. Sworn testimony after the armistice elicited, for example, at Camp Grant, that there was reckless 'cost-plus' construction. Four thousand carpenters were hired where 2,000 would have sufficed and would have completed the work possibly in less time at less cost. Laborers were paid 60 cents an hour, and when discharged as inefficient were rehired as carpenters at $9.60 a day. Cement and nails were ruined in great quantity by weather. Workmen loafed and at the end of the day would throw their tools in the mud, receiving new tools upon request.

"At Camp Sherman, Chillicothe, Ohio, evidence elicited that hospital plumbers loafed and gambled through weather 28 degrees below zero, while soldiers contracted pneumonia and died in great numbers. Joseph E. Poole, who had been employed at Camp Sherman, testified that nurses and doctors clad in sheepskin and fur coats attended sick soldiers lying in frigid buildings because the steamfitters refused to work on the heating system, and loafed in order to make the job last longer and the pay greater."

The cost-plus plan was the line of least resistance and was in some measure rendered necessary by the fundamental defects underlying the common conception of cost accounting principles. The argument advanced above that it was necessary to adopt this plan "because of fluctuating cost of materials and labor" is absurdly inadequate when we consider that "the government furnished everything." The price of nails may fluctuate but not the number of pounds of nails necessary to construct a building according to specifications—the hourly rate for carpenters may vary but the number of nails a carpenter should be expected to drive in a day is not dependent upon the price of labor.

If instead of being rewarded in direct ratio to their inefficiency the contractors had been paid a fixed amount for their services plus a substantial bonus for speed and economy in the use of material and labor the country would have been saved untold millions. Any engineer will testify that it would have been possible to have very closely figured the labor and material required to construct the camps and certainly no very great difficulty would have been experienced in instituting systems of cost accounting which would have clearly shown how closely the contractor adhered to the standards set and how much bonus he was entitled to for handling the work economically.

Of course, to some extent predetermined costs are used in all manufacturing concerns of any magnitude, this applying

particularly to plant improvement work where it is the usual practice to make an appropriation based upon the estimate of the man in charge of the work. Any plant manager can testify as to the difference in the manner in which construction work will be handled when there is a definite cost figured in advance and the engineer in charge held accountable for keeping to the figure of the appropriation, and where there is no standard fixed and no incentive to keep the cost to any definite figure.

This principle applied to all work performed will have the same effect as regards economical manufacturing. In a concern where standard costs are used, instead of working haphazardly toward more or less nebulous ends, every member of the organization is provided with definite incentives, responsibilities, and records of accomplishment.

In the majority of standardized industries such as that of the manufacture of automobiles, the price of the article to be sold is often set long before it is manufactured in sufficient quantities to enable compiled detailed costs to be a guide to the cost under quantity production conditions. Often the price of an article is set immediately the experimental model has been approved.

Standard Costs the Fundamental Improvement

The author joins issue with Benjamin A. Franklin's statement that the installation of adequate methods of cost accounting is the basic and fundamental factory improvement. The introduction of a system of standard or predetermined costs should, in the author's opinion, precede the introduction of scientific management in the shop, such as in the installation of methods of planning and dispatching. This particularly applies to those organizations where the will to be efficient is not fully developed, for the operation of a cost system along the lines mentioned will to a large extent of itself force upon such an organization the necessity for adopting the correct viewpoint and scientific management methods.

Once such a system of accounting is installed, the work of the efficiency engineer is greatly facilitated, and he can then introduce his changes gradually and with the full knowledge that the accounting system will at all times enable him to determine the extent to which his work is successful. The substitution of the scientifically calculated standards of the engineer for the

more or less arbitrary standards previously in force will present no particular problem.

Just as electricity is a standard form of power the uses of which are universal and far-reaching, so are scientific standards of operation of manifold usefulness. In brief, standard costs serve the following:

1 The foundation for setting selling prices
2 The incentive to manufacture for the price set
3 A gage of efficiency in manufacturing
4 A gage of selling efficiency
5 A common unit of measurement so that all cost information can be brought to a focus

By their scientific employment standard costs can be made to give results not possible in systems where they are not used. For instance, in a concern manufacturing a line of standard machines it is possible to adjust a standard cost to the basis of actual conditions with great facility.

The advantage of having some common unit of comparison for cost purposes will be evident to any manufacturer who has endeavored to bring to a focus the information presented to him by his cost department. This ideal is easily realized, of course, in the case of the manufacturer of a simple product, such as cement, where all cost data are naturally given in relation to the number of barrels of cement manufactured—labor so much a barrel, repairs so much, power so much and material so much. By the use of standard costs, however, the cost statement of a manufacturer of a line comprising several hundred machines, thousands of parts and tens of thousands of operations can be expressed as simply as those of the cement manufacturer, all costs being shown in relation to a common unit of measurement, namely, the dollar of standard cost.

Cost Accounting and Labor

Though it obviously does not come within the province of a treatise on cost accounting to deal exhaustively with the question of the relations between capital and labor, cost accounting methods are so intimately bound up with the conduct of industrial affairs that no work treating of cost accounting as a constructive force can be considered in any way complete which

does not give some attention to the bearing of cost accounting on the future relations between capital and labor.

Students of industrial progress are agreed that we are probably on the threshold of an era of material prosperity such as the world has never before seen. Within our reach are veins of wealth which when tapped will produce a flow of riches which will place the world in an economic position compared with which our present state must be regarded as one of comparative poverty. We have in our possession the means of doubling our present production of wealth, and of raising our standard of living; before us lies a clearly marked road, which, if we elect to follow it will bring us to a modern Utopia where men will work less hours and reap greater profits, and the human race at last come into its full inheritance.

Frederick Taylor in "The Principles of Scientific Management" makes the following statement:

> The general adoption of scientific management would readily in the future double the productivity of the average man engaged in industrial work. Think of what this means to the whole country. Think of the increase, both in the necessities and luxuries of life, which becomes available for the whole country, of the possibility of shortening the hours of labor when this is desirable, and of the increased opportunities for education, culture and recreation which this implies.

And there was probably no one better qualified to speak with authority in this matter than the late Mr. Gantt, to whom Charles W. Wood in "The Great Change" attributed the following:

> If our industrial machine were made to run at top-speed and maximum capacity, according to the laws of production which have already been discovered, America could win the war, pay for it out of hand, live in comparative opulence while we are doing so and be immensely richer at the close than we were ever before.
>
> On the whole only about 50 per cent of our industrial machines are actually operating during the time they are expected to operate; and on the whole these machines, during the time they are being operated, are producing only about 50 per cent of what they are expected to produce. This brings our productive result down to about one-fourth of what it might be if the machines were run all the time at their highest capacity.
>
> This conclusion is not a guess, but is based upon reliable data. Unfortunately there are many other elements of unnecessary waste in our productive processes which cannot be so accurately calculated but which reduce our effectiveness certainly to 20 and very probably to 15 per cent.

In "Man to Man," John Leitch writes as follows:

> My own opinion is that, considering the country as a whole, we have not during the past ten or fifteen years, secured more than 40 per cent

of our labor efficiency; that is we have wasted probably 60 per cent of our manufacturing capacity.

This is a stupendous waste—far greater than the wastage of war and it acts and reacts through our whole national organization. It prevents a just measurement of wages, lengthens hours unduly, and makes production costs and consequently sales prices unreasonable. The average commodity going through no particularly minute fabrication doubles in price from the raw material to the consumers, so this deplorable state of affairs hits everybody.

And Frank A. Vanderlip, President of the National City Bank, states:

There is good reason to believe that if in every department of production the efficiency of all labor were raised to the standard of the best present practice, the industrial output of this country would be doubled. Experienced industrial managers of wide observation go so far as to say it could be quadrupled, but if it should be increased 25 per cent, or even 10 per cent, by simply doing our work by better methods, all the cost of the war would soon be made up.

In the light of the above statements it does not seem far fetched to compare the old attitude of capital and labor toward each other to that of two dogs fighting over a bone and leaving untouched a large juicy steak lying just under their noses.

Entirely aside from the ethics of the matter, however, it is obvious that unless a fair distribution of the benefits derived therefrom is guaranteed to labor, capital can never obtain its coöperation in the adoption of the necessary steps towards increasing efficiency. These are days when momentous changes are in the air, as the late George W. Perkins wrote:

. . . we are entering a new period of relationship between capital and labor. In the long ago this relationship was that of owner and slave; then came the period of master and man; then the period of employer and employee, each period being a decided step forward. I believe that we are just now entering a period of co-partnership, when the tool user will be part tool owner and when capital and labor will share more equitably in the profits of the business in which they are jointly engaged.

Mr. Perkins, as is well known, was a strong advocate of profit sharing in its true sense, which he defined as follows:

By profit sharing I do not mean bonus giving. I mean actual profit sharing based on the earnings of the business, with a fair percentage to capital and a fair percentage to labor after ordinary wages and interest have been earned. Profit sharing can be practiced satisfactorily only when the business concern makes its transactions public, so that the laborer

and the stockholder can know as much about the business as the manager himself. In the adjustment of difficulties between capital and labor I am confident that open books will accomplish much more than open shops.

But much as he respects Mr. Perkins' judgment in other matters the author must confess that in his opinion Mr. Perkins overrates the capacity of the average working man to perceive the relationship between causes and their ultimate effects. The ordinary human being is so constituted that to call forth his best efforts demands that there should be some clearly shown direct relationship between these efforts and their reward, and it calls for no little powers of imagination for a worker at the bench to see any direct relationship between his personal efficiency to-day and the annual profits of the huge corporation which employs him.

For the laborer to "know as much about the business as the manager himself," to use Mr. Perkins own words, calls for a higher calibre of mentality in laborers than they usually possess. Unquestionably, a policy of profit sharing creates a community of interest between employer and employee which is of tremendous value in the establishment and maintenance of harmonious relationship, but if the object in view is the raising of the efficiency of an organization to a 100 per cent basis in the author's opinion at least, this cannot be accomplished by any general distribution of profits.

In one respect, however, profit sharing presents an advantage over a plan under which there is a more direct relationship between the personal efforts and reward of the employees. The introduction of a system of profit sharing is a comparatively simple matter—the directors decide, for instance, that all profits over 5 per cent on the capital stock shall be divided between the stockholders and the employees on a 70-30 basis or in any other proportions that may be decided upon—a notice is then sent to the employees advising of the action taken by the directors and the matter then resolves itself into a simple matter of bookkeeping. On the other hand, the introduction of a system whereby the employees are to be rewarded in accordance with their efficiency calls for the determination of standards for all activities and the installation of methods of accounting which will furnish reliable information relative to variations from these standards and which will distinguish between cost variations over which the employees can properly exercise control and those which are dependent upon causes outside of their sphere of influence.

In the author's opinion, John Leitch more nearly approaches the solution of the problem in his "Industrial Democracy" plan, in any event there is a more direct relation between the worker's effort and his reward under this plan than there is under the general profit sharing plans which Mr. Leitch criticizes as follows:

> After a long investigation of many systems I have concluded that it is unfair to permit the compensation of the worker to depend upon any factor which he does not control; he may do his work well and find that there are no profits because the company did not sell at a proper price, or granted improper credits, or did any one of the thousand things which lose money. If under profit sharing he does his work and gets no dividend he is very properly dissatisfied.

Mr. Leitch's plan for giving the worker a direct interest in the business is to share with him the savings resulting from economies. This plan in his own words is as follows:

> Here is how it works in practice. I take the cost of a unit of production in the period preceding the introduction of Industrial Democracy and compare that cost with the results after democracy has gone into effect. If there is a saving, then one-half that aggregate saving is the amount of the economy dividend for the period and is paid to the men as an added percentage to wages. This is a dividend upon service. It should be paid at intervals not longer than two weeks, to preserve it as a matter of current every-day interest.

There is sound psychology underlying Mr. Leitch's plan—consider for a moment the stimulus of a two-weekly distribution based upon the actual results realized by the workers compared with that resulting from an annual dividend based largely upon a showing over which the worker may have little control. In a factory where Mr. Leitch's plan was operating, there would be little need of close supervision by the management of the individual worker, for this would be undertaken by the workers themselves. The author once visited a small factory where the proprietor saved the expense of checking the employee's piece work earnings by letting the workers calculate these themselves and post them on a board in a conspicuous place in the shop, relying on the fact that any worker who overstated his earnings would be called to account by his fellow workers.

If this plan worked successfully, and the manufacturer who used it claimed that it did, how much stronger would be the moral effect of a plan like Mr. Leitch's where an employee to get more than was due him would be robbing his fellow em-

ployees! As to this feature of his plan, Mr. Leitch has the following to say:

> The man who came into that shop and acted as if he were working *for* and not *with* the boss soon got his awakening. The men held a slacker as no better than a thief for he was stealing from them by helping to cut down dividends.

Now it will be obvious to students of accounting that the ordinary systems of cost accounting are totally unsuitable to meet the accounting demands which would be made by Mr. Leitch's or any similar plan. The great majority of cost systems are designed with one purpose only in view, namely, the ascertaining of the cost of the articles manufactured, and are so absolutely inelastic that it is a hopeless matter in most cases to apply them successfully for any other purpose than the narrow one for which they were created.

There is something almost sublime in the lofty manner in which engineering and other non-accounting writers dispose of the complex accounting problems which touch upon their own undertakings. Mr. Leitch is no exception to this rule—he devotes a single brief paragraph to explaining how the trifling detail of the accounts is handled and then hurries on to matters of greater moment. What he has to say on the subject of accounts is as follows:

> Now for the first question—the calculation of the dividends when costs are rising. Economy is a relative term. I calculate the *relative* saving in cost of production. Suppose wages, materials, etc., have risen 50 per cent over a former period but production costs have gone up only 30 per cent—then have not the production costs relatively decreased? I take it that they have and award dividends upon this basis.

Simple, is it not? First we "take the cost of a unit of production in the period preceding the introduction of Industrial Democracy" and then we "calculate the relative saving in cost of production" and that is all there is to it! Obviously, the whole question of justice to the management and the worker depends upon the accuracy of the method of figuring the saving, and if Mr. Leitch wished to be really helpful to those who desired to put his plan into effect it would seem as if a little more practical information on this subject would have been distinctly to the point.

A test of the soundness of any general theory is whether it is capable of universal application and in the final analysis

Mr. Leitch's method of figuring "economy dividends" will be tried in this crucible. Taking the case of one simple product, for instance that of cement, no particular difficulty should be experienced in figuring the "cost of a unit of production" and the "relative saving in cost of production" along the lines Mr. Leitch suggests, but how does he propose to figure those things in the class of undertaking with which the author is most familiar, where a single factory will manufacture thousands of different articles involving tens of thousands of different operations and at the end of a two-weeks' period the factory floors will be loaded with work in process in various stages of manufacture? Is it then a simple matter to figure the cost of all the different units of production and the "relative saving in cost of production" every two weeks?

Another question, and that is whether Mr. Leitch's methods are intrinsically just. Assume, for instance, that there are two factories which previous to the introduction of "Industrial Democracy" are respectively 25 and 50 per cent efficient and that after "Industrial Democracy" is in full blast they both reach an efficiency of 80 per cent. That is to say, productive operations which on a basis of 100 per cent efficiency should cost $100 before the introduction of "Industrial Democracy" cost $400 and $200 respectively, and that afterwards the cost in both factories is reduced to $125. In the first case, for every hundred dollars' worth of production, figured on a 100 per cent efficiency basis, the workers will receive one-half of the saving of $275 or $137.50, while in the second case they will only receive one-half of the saving of $75 or $37.50. The example may be an extreme one, but the principle applies, and considered from this viewpoint Mr. Leitch's plan, though providing a reward for ultimate competency, also furnishes a premium in proportion to the original incompetency. Imagine Mr. Leitch's plan in more or less universal operation and it is reasonable to suspect that there would be difficulty in getting workers for a factory which was operated with a fair degree of efficiency previous to the introduction of "Industrial Democracy," for obviously it would be far more profitable to work for the concerns which were most hopelessly inefficient previous to the adoption of Mr. Leitch's methods.

In using past results as his basis of comparison, Mr. Leitch's methods cannot but be considered as a step backwards. The whole conception of modern industrial thought as represented by scientific management is based on the setting of standards of

possible attainment and Mr. Leitch's plan of making his comparisons with past results is in line with the fundamental defect in cost accounting methods generally which are confined to recording and comparing past accomplishments expressed without relation to standards.

A really equitable plan for the sharing of savings resulting from increased efficiency demands first the determination of standards for all operations—standards of time, of material consumption, and of quality of product, and second a really scientific system of cost accounting which in addition to showing the actual efficiency realized will enable a clear distinction to be made between the effect of factors over which the workers have control and those which are beyond their power to influence. Furthermore, the cost system should have constructive value in pointing out the causes contributing to a failure to realize the standard set. In addition, the plan should be such as to enable comprehensive statements to be furnished the workers in such form as to be intelligible to them. As Mr. Perkins states, "open books will accomplish much more than open shops" and it is easy to believe that we are approaching a time when manufacturers will realize that it is a good policy to take their workers to a greater extent than before into the councils of management. It is hardly consistent to keep workers entirely in the dark as to the fundamental facts of business and then to complain that through ignorance of these facts they sometimes make absurd and unjust claims. The ignorance of the average worker of fundamental economic facts, if somewhat appalling, is not surprising when one considers how little opportunity he has to become acquainted with these facts, and how distorted is the information which is often handed him by his leaders.

The essential features which a cost system should possess in order to furnish the means for equitably figuring savings in costs for distribution to workers, which were enumerated above, are also those which a manufacturer should demand of a cost system to meet his own requirements in connection with the management of his business. These requirements are met by the scientific methods of standard or predetermined cost accounting described in this volume.

The Influence of Scientific Methods on Industrial Progress

Our present civilization differs from all previous civilizations in one fundamental respect. Ancient civilizations rose to a certain point and then having failed to find the key to continued progress advanced no further and ultimately crumbled to ruin. Excavations made on the site of ancient Nineveh revealed great libraries of books consisting of bricks and cylinders of various sizes with inscriptions transcribed on them while in the state of clay and rendered indelible by subsequent baking, some of the tablets discovered dating as far back as 4500 B.C., while Assyriologists in general are inclined to believe that a high state of civilization had been attained in Mesopotamia at least 9000 years ago. The significance of these discoveries was well described by the historian William Gates when he wrote:

> We may note at once how these new figures disturb the historical balance. If our forerunners of eight or nine thousand years ago were in a noonday glare of civilization, where shall we look for the much talked of "dawnings of history"? By this new standard the Romans seem our contemporaries in latter day civilization; the "Golden Age" of Greece is but yesterday; the pyramid-builders are only relatively remote. The men who built the temple of Bel at Nippur in the year (say) 5000 B.C., must have felt themselves at a pinnacle of civilization and culture.

The "open sesame" to the door of progress, which the ancients lacked, and the factor which rendered possible the remarkable advance in knowledge of recent centuries was the development of the scientific method—that process of trial and error under which each tentative theory advanced is submitted to the check of experiment and accepted or rejected on this basis.

The Greek philosophers failed to develop scientific method, owing to their tendency to formulate broad, general theories without submitting these to the acid test of experiment, so that they would build up an elaborate structure on a foundation of false premise, a classical instance of this being Aristotle's doctrine that of two weights dropped from a height the heavier would fall the faster. Observing probably that pebbles dropped to the ground quicker than feathers the philosopher rashly assumed that the heavier the thing was the quicker it would fall, and overlooking the factor of air resistance concluded that "bodies fall with velocities proportional to their weights," a

doctrine that was universally accepted for over nineteen hundred years and which formed the basis of many a learned discussion. It remained for Galileo in 1590 to apply scientific methods in the testing of the correctness of Aristotle's doctrine which as is well known he did by dropping weights from the leaning tower of Pisa and establishing the fact that bodies do not fall with velocities proportional to their weights and that except for the resistance of the air all bodies would fall through the same space in uniform time.

It was due to the diffusion of the scientific spirit and scientific methods that in the space of two brief centuries man made a greater advance in his control over natural forces than in the thousands of years previous. What a staggering advance was made between the years 1700 and 1900! In 1700 the first practical steam engine had not been constructed and over a hundred years were to elapse before George Stephenson's "Puffing Billy" ushered in the era of steam locomotion, and Robert Fulton's *Clermont* demonstrated that steam navigation was a practical commercial possibility. Probably if one of the inhabitants of Nineveh in the good old days seven thousand years B.C. could have returned to this earth about A.D. 1700 he would have found less to astonish him than would the Pilgrim fathers if they could to-day revisit the country in which they found refuge from religious persecution.

It is hardly necessary to enlarge upon the tremendous development of industry in the last few decades due to the introduction of scientific methods in business, but owing to our unfortunate habit of making comparisons of current achievements mainly with past results and without reference to what we could attain if we realized our full possibilities, we fail to perceive that remarkable as our achievements may have been through the adoption of scientific methods they fall lamentably short of what lies within our powers. As William C. Redfield says in "The New Industrial Day":

> So splendid have been the results of our industrial growth, so brilliant the victories of our manufacturers at home and abroad, so astonishing the inventive skill with which by special tools and new appliances we have reduced the cost of our production, so matchless has been the courage with which some of us have forsaken the old and taken up the new, that we are apt to lose sight of the fact that these achievements and this brilliancy and fine courage have been the characteristics of the few rather than of the many, and that most of our industries are still laggards in the race.

The desire to excel is inherent in human nature—we do not like to feel that we are less efficient than our neighbors and even the slackest of farmers will generally keep the weeds out of the fields that adjoin the travelled road. Business men as a whole are ambitious to achieve the best results and no manufacturer worthy of the name would be satisfied to have his business continue in a state of marked inefficiency if he could be convinced that this condition really existed. The problem, therefore, resolves itself largely into one of education in providing means for furnishing every manufacturer with correct information as to how closely he realizes the inherent possibilities of his business, and further as to where and why he has failed. Provide a manufacturer with periodical statements showing how many thousands of dollars he is throwing away each month because through lack of proper methods of planning his work his machines are operating at a fraction of their potential capacity and it will not be long before he has taken the necessary steps to properly operate his plant. Furnish a sales manager with statements showing that through lack of orders resulting in the factory being operated at less than full capacity $20,000 a month is being added to the cost of the goods which are being produced, and the chances are that with this information before him he will figure out some way to obtain enough business at a reduced price to eliminate that $20,000 from subsequent statements.

The first step towards correcting an error is determining its existence. As Sir Francis Bacon wrote: "Truth to emerge sooner from error than from confusion" and the first step on the road towards efficiency is to know definitely not how our methods of to-day compare with yesterday, but how they stack up in comparison with what industrial science has proved to be possible; to quote once more from Mr. Gantt, who saw so clearly and spoke so fearlessly:

> We claim to be an industrial nation. I feel we are only just beginning to be an industrial nation, and shall not be fully entitled to that name until we have a complete knowledge of the principles on which successful industry is based.
>
> Too many of our enterprises are still founded on what has been done rather than on what can be done. *The real industrial leader must be guided by future possibilities rather than past performances.*

The author has italicized the last sentence for in these few words he feels that Mr. Gantt strikes the key-note of this volume.

COST OF SALES

The same principle is employed in figuring cost of sales as is followed in the case of ascertaining current costs the average ratios of actual to standard material, labor and burden being applied to the standard costs of the goods shipped. In the case shown the increase of actual over the standard cost of the goods shipped due to the causes analyzed in detail on the Summarized Manufacturing Efficiency Statement, was as follows:

	Total	Per 10,000 units
Increased actual cost compared with standard	$1,936.55	$ 9.68
Reducing the standard profit of	3,842.00	19.21
To an actual profit of	$1,906.45	$ 9.53

COST OF SALES

STATEMENT OF COST OF SALES

No. of Pieces Shipped 2,000,000

G

	STANDARD PER 10,000 PIECES	STANDARD TOTAL FOR 2,000,000 PIECES	RATIO ACTUAL TO STANDARD	ACTUAL	INCREASED COST TOTAL	INCREASED COST PER 10,000
MATERIAL	68.60	13,720.00	1070	14,252.40	932.40	4.66
LABOR	13.14	2,628.00	105.5	2,775.17	147.17	.74
BURDEN	31.05	6,210.00	113.8	7,066.98	856.98	4.28
TOTAL	110.79	22,158.00	108.7	24,094.55	936.55	9.68

PIECES	AMOUNT PER 10,000	AMOUNT TOTAL

The Principles of a Cost System Based on Standards

The underlying principles of a system of cost accounting based upon the use of standards may best be understood by considering an exceedingly simple illustration. Accordingly, in Figure 3 is shown in diagram form the essential features of a system of cost accounting to meet the requirements of a hypothetical case, in which it is assumed that a manufacturing concern has accepted a contract for the manufacture of several million machine bolts at a price of $13 a thousand. It is further assumed for the sake of simplicity that the business in question is confined to the performance of this contract.

Before making a bid for this work the cost department has been instructed to make a careful estimate of the cost of making this bolt and in the standard cost card shown in Form I it will be seen that the estimated or standard cost of the bolts is $11.079 per thousand and, therefore, the estimated or standard profit on the contract is $1.921 a thousand.

This diagram illustrates the following important information obtained by the use of standard costs:

1 Manufacturing efficiencies
2 Current costs
3 Cost of sales

1 Manufacturing Efficiencies

The executive of a concern engaged in the carrying out of a contract such as has been described is primarily interested in knowing the extent to which the actual costs vary from the standard and the causes underlying these variations. All of his plans are based upon the assumption that he is going to realize his standard profit of $1.921 per thousand and, the selling prices of the bolts being fixed, his activities will be solely directed to keeping the manufacturing cost to the standard or below it. The variations from standard are brought to a focus on the summarized manufacturing efficiency statement (Form A) which shows the actual and standard expense of material, labor and burden, and the increases or decreases comparing actual cost with standard, the former being shown *in red* and the latter *in black*.

Considering this statement in detail, obviously the first thing that will strike the eye of the executive is the red ink figure

showing that the actual cost of the month's operations is $2816.30 in excess of standard this increase analyzed under the heads of material, labor and burden being as follows:

Material	$1395.00
Labor	210.30
Burden	1211.00
Total	$2816.30

This increased cost, which represents 8.7 per cent of standard, is obviously a serious matter for the standard profit on which the executive has calculated represents only a little over 17 per cent of standard cost, so that it may be assumed that he will immediately institute a searching enquiry as to the reasons why his plans have so sadly fallen down, so that prompt steps can be taken to eliminate all preventable inefficiencies and reduce costs as nearly as possible to the standard adopted.

Following the same process as the executive would, we will consider each item of cost appearing on the summarized manufacturing efficiency statement individually and in the order in which they appear on the statement.

Material. The increased cost of material totalling to $1395, details of which are shown on the summarized material report (Form C), is divisible as follows:

Due to price fluctuations	$1,125.00
Due to fluctuations in use efficiency	270.00
Total increase	$1,395.00

The increased cost due to price fluctuations is made up as shown in Table 1:

TABLE I. FLUCTUATION IN COST OF MATERIAL

	Pounds	Price	Amount
Actual cost of material used in month	1,125,000	$1.90	$21,375.00
Standard cost of material used in month	1,125,000	1.80	20,250.00
Increase of actual over standard	.....	$0.10	$1,125.00

The increased cost of 0.610-inch round steel of $0.10 per hundred pounds is apparently due to a serious error in figuring the standard cost of this material at $1.80, for the material account (Form B) indicates that the actual cost of the material received during the month, per hundred pounds, was as follows:

Purchase price	$1.75
Freight inward	0.13
Handling expense	0.02
	$1.90

The material presumably having been bought on contract, the freight being a fixed charge, the only possibility of reducing this loss resulting from price variations would be as regards the small expense of handling. Here obviously it would be desirable to adjust the standard cost and the plans based thereon.

The increased cost of material due to the quantities used being in excess of standard will then call for attention. This increase is made up as shown by Table 2:

TABLE 2. FLUCTUATION IN USE OF MATERIAL

	Pounds	Price	Amount
Actual material consumption figured at standard price	1,125,000	$1.80	$20,250.00
Standard material consumption figured at standard price	1,110,000	1.80	19,980.00
Increased material consumption figured at standard price	15,000	$1.80	$270.00

The standard consumption shown above is obtained by extending the standard quantity of material as shown on the standard cost card (Form I) by the number of bolts cut off as shown on the summarized material report as follows:

Standard quantity of material per 10,000 bolts	3700 pounds
Standard quantity of material per production of 3,000,000 pieces 3700×300	1,110,000 pounds

The details of the material used would be obtained from the detailed material requistions which would show for each batch

of parts cut the material actually used and the standard. From these, daily reports would be made for the executive showing the extent of the variations between actual and standard. These requisitions would be analyzed by machines so that inefficiencies could be traced to individual operators. By this means the manufacturing executive could maintain the closest supervision over the use of material.

Labor. The total increased labor cost of $210.30 comparing actual with standard, as shown by the summarized manufacturing statement, is made up as shown by Table 3:

Table 3. FLUCTUATION IN LABOR COSTS

Operation	Actual Expense	Standard Expense	Increases or Decreases Due to Fluctuations in Rates		Increases or Decreases Due to Fluctuations in Efficiency	
			Increase	Decrease	Increase	Decrease
Cut off.....	$299.00	$300.00	$11.50	.....	.....	$12.50
Head.....	2349.00	2,349.00	.....	$81.00	$81.00	.....
Point.....	378.00	291.20	14.00	.....	72.80	.....
Thread.....	904.50	780.00	67.00	.....	57.50	.....
Totals....	$3,930.50	$3,720.20	$92.50	$81.00	$211.30	$12.50
Net Increase or Decrease	.....	.....	$11.50	.....	$198.80	.....

In the summarized production and payroll report (Form D) is illustrated the manner in which the variations in labor costs are determined. The standard productive hours and payroll figures are obtained by extending the standard hours and amounts as shown on the standard cost card (Form I) by the production as appearing in the column so headed on the summarized production and payroll report (Form D). The increases and decreases in the cutting department are arrived at as shown by Table 4:

The variations in labor cost for the other departments are obtained in the same manner as illustrated above for the cutting department.

The importance of distinguishing between labor cost variations resulting from changes in the rates paid per hour and

those due to variations in the productive efficiency of the operator is demonstrated in the comparison shown above for the heading department, where the actual cost totals the same as the standard and which ordinarily would be passed by, whereas the saving of $81 resulting from decreases in the rate per hour is offset by the decreased efficiency of the operators. In the illustration given it is assumed that the burden rate per hour of the cutting department is $0.30 while that of the operator is only $0.25, so though the employment of operators inferior to standard has not resulted in any direct labor loss the 50 hours taken over standard represent a burden loss of $15.

TABLE 4. FLUCTUATION IN CUTTING LABOR COSTS

	Hours	Rate per Hour	Amount
Standard			
Per 10,000 pieces per standard cost card (Form I).	4	$0.25	$1.00
Per production of 3,000,000 pieces (Form C)....	1200	0.25	300.00
Actual			
Per Form D.....	1150	0.26	299.00
Increase			
Due to increase in rate paid per hour.....	1150	0.01	11.50
Decrease			
Due to increased efficiency, as compared with standard.....	50	0.25	12.50
Net decrease.....	....	....	$1.00

Burden. The principles underlying the distribution of material and productive labor are simple and straightforward, as such expenditures can be directly applied to the operation or item of product manufactured, accordingly in the distribution thereof there is little difference among accountants as to the general rules to be followed. In the case of general expense or burden, however, it is not possible in the majority of cases to trace any direct relationship between the expenditure and the individual item of product, and the problem of providing methods whereby each article manufactured will be charged with a share of such expenditures in proportion to the benefits which accrue to it therefrom is an exceedingly complex one.

In the earlier days of manufacturing when little machinery was employed and that of a simple character, the question of proper methods of burden distribution was of relatively minor importance as the burden expense represented but a small percentage of the labor cost involved in the manufacture of an article. In these days however of machinery, expensive to purchase and costly to maintain, and where one operator may have charge of six or more machines at a time, the burden cost will often many times exceed the operating payroll. Accordingly the problem of burden distribution is very vital, and one upon the successful solution of which the prosperity or failure of a business may depend.

In spite of the importance of proper methods of burden distribution there are still found manufacturers who are content to figure the burden factor in their costs on some such crude basis as by adding to the labor cost of the article the same percentage which the total burden bears to the total productive labor of the plant, regardless of the fact that one item of product may involve 90 per cent hand work, while with another the same percentage of work would be performed on expensive automatic machines. Such methods have undoubtedly been the basic cause underlying the failure of many a manufacturer and the salvation of more fortunate, but no less incompetent concerns, has probably often been due to the fact that their competitors were equally ignorant of the proper way in which to figure the actual costs of production, so that they all operated under the same handicap.

It is often necessary to introduce somewhat elaborate methods of burden distribution if even approximately correct costs are to be obtained. As an instance of the importance of such refinements may be cited a case where the methods employed were considerably in advance of those followed in the average concern and yet where the result obtained was very far from being correct. Here the burden was carefully analyzed by departments and distributed to the work passing through the department in proportion to the productive labor expended on the item of product. With a view to testing the accuracy of this method of distribution, a study was made of the work performed on some automatic machines as compared with that undertaken on a simple machine in the same department, the burden being distributed on a uniform basis namely as a percentage of the labor chargeable to the job. In the former case there were several expensive machines operated by one workman with an

assistant. In the latter there was a simple inexpensive machine requiring the full attention of a single operator. The following statement shows in comparative form the more important distinctions between the conditions attending these machines:

Automatic Machines	Simple Machine
One operator with an assistant can take care of as many as six machines at a time and figuring the payroll of these two at a total of say $6 a day gives a productive labor cost per machine of $1 a day.	One operator for one machine with a daily wage of, say, $3.50.
Relatively heavy tool expense.	Relatively small tool expense.
Relatively expensive maintenance of machine.	Relatively low maintenance expense.
High power consumption.	Low power consumption.

It was found in the case illustrated above that the actual operating and maintenance expense per day on the automatic machines (other than productive labor) was at least three times as great as on the simple machine so, assuming that the method of distribution employed to result correctly as regards work performed on the automatic machines, as regards the work done on the simple machine the burden charged would be 10½ of what would be equitable. This conclusion is arrived at as follows:

Assume that the daily cost of operating and maintaining the automatic machine (other than productive labor) is $3. The daily cost of operating the simple machine (which as stated above is one-third of the automatic machine) is therefore $1. The daily productive labor cost on each automatic machine is $1, therefore the cost of $3 a day for operating and maintaining the machine represents 300 per cent of the productive labor cost. On this basis under the distribution plan employed, the daily burden charge to work performed on the simple machine would be 300 per cent of the daily productive labor cost of $3.50, or $10.50. But as stated above it was found that the actual burden chargeable to the simple machine should be only $1 a day. Therefore, assuming that the method of burden distribution adopted is correct for the automatic machines, work on the simple machine is charged with 10½ times what it should bear.

The above is, of course, an extreme but not unusual case and illustrates the danger which lies in using averages in figuring

burden in a plant where the work performed is not of a uniform character.

In the hypothetical case shown in Figure 3 there is only a single item of product being manufactured to which all expenditures must ultimately be charged and, considered from the basis of an exposition of methods of burden distribution to meet complex conditions, this illustration is imperfect by reason of excess of simplicity. Accordingly a description of methods of burden distribution suitable for a plant manufacturing an extensive and varied line of product will be deferred to a later chapter where accounting methods to meet such requirements will be fully described.

The situation reflected in Figure 3, however, lends itself admirably to illustrating an important feature in connection with burden distribution, which in the main is not dealt with in the voluminous literature on this subject. As was previously stated, the usual cost accounting horizon is limited to *costs* to the exclusion of *causes*, the work of the cost accounting department being confined to a distribution of actual expenditures without regard to their relationship to standards. Accordingly, no distinction can be made as between expenditures which result in full value being received and those which in large measure are wasted owing to incompetence and inefficiency.

In reality, the usual forms of cost accounting confine the records to one side of the ledger, very complete and elaborate analyses being made of the actual expenditures representing the debit side of the account while the credit side, showing the value of the services resulting from such expenditures, is entirely omitted. This one-sided form of accounting shows a similar lack of appreciation of relative values to that displayed by those plant superintendents who pay a great deal of attention to insuring that by no possible chance can an employee be paid for a minute more than the time he spends on the premises, but in the main overlook the question as to whether from the employer's standpoint the employee is profitably engaged during the period for which he is being paid.

It is a somewhat singular fact that under the accepted methods of valuing inventories at cost, it is perfectly proper for a public accountant to certify as to the accuracy of the inventory item on the balance sheets of two concerns next door to one another and manufacturing identical products, while owing to wasteful and inefficient methods the cost of manufacture of one is 20 per cent more than the other, *so that as regards the inventory*

item, at least, it may be stated that the greater the inefficiency the more valuable the asset. Of course no auditor would accept a cost valuation in excess of selling price if his examination disclosed this fact, as it doubtless would, but within limits the statement made is correct.

The far-reaching consequences resulting from what Mr. Polakov calls "this fatal misconception of what constitutes the cost of a commodity" are ably described in his articles on "Mastering Power Production," published in *Industrial Management* during 1918. It is beginning to be realized that the wasteful and inefficient manufacturer is not solely his own enemy, but that of his employees and of the community at large. In the long run the ultimate consumer pays for all inefficiencies and the manufacturer who wastes material and human labor is to this extent contributing to the high cost of living, and hastening the day of the exhaustion of natural resources.

The obvious solution of the problem is, first, the determination of the necessary or standard cost of manufacture and, second, the separation of expenditures between those which are necessary and those which are the result of inefficiencies. As Mr. Polakov states: "an accurate knowledge of the excess of expenses over the necessary cost of production leads almost inevitably to the discovery of means for eliminating this waste."

A somewhat elementary illustration of the operation of such a plan is given in Figure 3. Reference to the summarized manufacturing statement (Form A), already referred to in connection with material and labor, will show that the burden expense is given both as regards the actual amount spent and the standard, as follows:

Actual burden	$10,019.50
Standard	8,808.50
Excess cost	1,211.00

As every manufacturer knows, the burden charge to product tends to vary inversely to the volume of product, as a certain proportion of the expense included in burden is in the nature of a fixed charge not varying with the production, and this feature of burden costs is the underlying cause for the effort made by manufacturers to decrease costs by increasing production. In Figure 3, therefore, a distinction is made between these fixed charges and those of a fluctuating character, the excess of total actual burden over standard burden being analyzed as follows:

Fixed charges:	
Increase due to variations in expenditures	$787.00
Increase due to variations in production	129.20
Fluctuating charges:	
Increase due to variations in actual expense compared with standard expense	294.80
Total increase	$1,211.00

In making the distinction between fixed and fluctuating expenses it is assumed that careful estimates were prepared of what the expenses should be in order to handle the estimated production of 3,000,000 bolts per month. A certain organization would be required to carry along this contract which would not be affected by minor variations in production, this also applying to rent, insurance, etc., and such expenditures would be included under the head of fixed charges. The expenditures coming under the head of fluctuating charges would be such items as tools, machine repairs, and power which would tend to vary directly with the production. Foremen, carried on a monthly basis in this case, would be considered as a fixed charge.

As was previously indicated two factors would enter into variations between the actual and standard fixed charges, those resulting from the actual expenditures incurred being more or less than the estimates or standards and those due to the production being at variance from the standard or estimate of 3,000,000 bolts per month in all departments. The effect of the first of these factors is the loss of $787 shown above, which amount would, of course, be analyzed by classes of expense so that the increases could be localized and steps taken to eliminate them from future statements. As regards the second factor, reference to Form D on Figure 3 will show that whilst the standard production was realized in the cut-off department, the production of the heading, pointing, and threading departments was 100,000, 200,000 and 400,000 short of the standard, respectively. This results in the expenses requiring to be absorbed by a smaller production than was estimated, or an increased cost as compared with standard of $129.20. The remedy for the plant manager to apply in order to eliminate this item of increase on the succeeding manufacturing efficiency statement is obvious.

In the standard cost (Form I) burden is figured on the basis of a certain number of standard hours at a standard rate per hour. For instance, the standard burden cost for the heading

department per 10,000 bolts is $13.50, obtained by extending 27 standard hours at a standard rate per hour of $0.50. This standard rate of $0.50 is divisible into:

Fixed charges	$0.03 per hour
Fluctuating charges	0.47 per hour

The method employed in ascertaining variations between actual and standard burden is illustrated in Form E on Figure 3, the variations being figured as follows:

FIXED CHARGES		
Estimated monthly expense for handling contract of 3,000,000 bolts (Form J)	$243.00	
Actual expense for month (Form E)	250.00	
Increase due to fluctuations in expense		$7.00
Standard hours on basis of 3,000,000 bolts per month (Form J)	8,100	
Standard hours earned on production of 2,900,000 bolts (Form E)	7,830	
Decrease in standard hours	270	
Standard rate per hour	$0.03	
Increase due to production being less than standard		$8.10
FLUCTUATING CHARGES		
Actual expense for month (Form E)	$3,962.00	
Standard expense for month 7,830 standard hours at standard rate of $0.47 per hour	3,680.10	
Increase comparing actual with standard		$281.90
Total increase		$297.00

2 CURRENT COSTS

In Form F on Figure 3 is illustrated the method by which current costs can be obtained by adjusting the standard cost to the basis of current conditions by the use of the ratios of actual to standard cost as appearing on the inventory account (Form H). In Form H the adjustment factors for labor and burden are taken in total instead of by individual operations, a slightly

different result being obtained by figuring the adjustments by the factors for the different departments. This is drawn attention to at this point in order to emphasize the fact that all costs must be more or less approximate however elaborate the methods of distribution may be, and in many cases time can safely be saved by using averages in place of detailed figuring, especially in the event that the figures used cover a period of several months so that variations in work in progress at the commencement of the period and the close are so small as to very little affect the final result. Of course, in a case such as that illustrated in Figure 3, where one very simple product is manufactured the figuring of each operation by its individual adjustment factors would be a matter of small moment, but in a case where it is necessary to adjust the standard cost of a machine which embodies a thousand or more parts such a proposition would involve a great deal of detailed work. With a properly designed system however standard costs can be easily and safely adjusted by the use of very few adjustment factors.

Standard costs can be used not only as a basis to figure costs under current conditions but also, as Mr. Franklin suggests, as a foundation on which to make estimates or predictions of costs. In this connection it should be noted that to obtain the fullest value from the use of standard costs calls for the exercise of the faculty of imagination on the part of the cost accountant. The ability to make intelligent forecasts will be an essential qualification of the cost accountant of the future, and the demand which will come for a wider range of ability on the part of the cost accountant cannot fail to result in the importance of his position being recognized, and its status raised from its present rather low point to one commensurate with the essential character of the functions it performs.

3 Cost of Sales

The method illustrated in Figure 3 (Form G) for ascertaining the cost of sales or more properly of shipments is the same as that previously described for figuring current costs, the standard cost being adjusted to the basis of actual conditions by the use of the ratios of actual to standard as appearing on the inventory account (Form H). Reference to Form G will show that the number of bolts shipped was 2,000,000, comparison between the standard and actual cost of these bolts being

as shown in Table 5. Table 6 gives a comparison of standard and actual profits.

TABLE 5. ACTUAL VS. STANDARD COST OF BOLT

	Actual Cost		Standard Cost		Increased Cost	
	Total	Per 10,000	Total	Per 10,000	Total	Per 10,000
Material.....	$14,252.40	$71.26	$13,320.00	$66.60	$932.40	$4.66
Labor.....	2,775.17	13.88	2,628.00	13.14	147.17	0.74
Burden.....	7,066.98	35.33	6,210.00	31.05	856.98	4.28
Totals....	$24,094.55	$120.47	$22,158.00	$110.79	$1,936.55	$9.68

TABLE 6. ACTUAL VS. STANDARD PROFITS ON BOLTS

	Actual		Standard		Increase or Decrease	
	Total	Per 10,000	Total	Per 10,000	Total	Per 10,000
Sales.....	$26,000.00	$130.00	$26,000.00	$130.00	.....	....
Cost of sales..	24,094.55	120.47	22,158.00	110.79	$1,936.55	$9.68
Net profit....	$1,905.45	$9.53	$3,842.00	$19.21	$1,936.55*	$9.68*

* Decrease.

Chapter III

THE UNIVERSAL LAW OF SYSTEM

ALL of a man's most cherished possessions will not be found on the schedules of an appraisal of his property, and the assets of a business most difficult to acquire or to replace do not all appear on its balance sheet. Prosperity and even the continued existence of a business depend as much upon its intangible assets, upon its good will, its policies and the spirit of its organization as upon its buildings, machinery, and other material evidences of its prosperity.

Andrew Carnegie is reported to have stated that if he were compelled to take his choice between suffering the total destruction of his physical properties or building an entirely new organization to operate his business he would choose the former alternative. Master of organization as he was, the shrewd old Scotch ironmaster knew full well that while machinery can always be purchased by those possessing cash or credit and but a few months would be required to replace his physical plants, the building up of an efficient and loyal organization must necessarily be the work of years. The same thought was admirably expressed in an advertisement of a well-known manufacturer which recently appeared as follows:

> An organization may be likened to a fine machine. It may be well designed, its parts may be accurately made and carefully assembled, but its highest efficiency is reached only after it has been "run in" and its components brought into thorough accord.
>
> The "running in" process of the machine may be a matter of days or weeks, but in a huge organization it is a matter of years.

However carefully an automobile engine may be assembled—however finely its various parts may be fitted—it should run a great deal better after being operated a thousand miles than it does when it first leaves the shops. How much more comfortable than the brand new ones we purchase are the well-worn shoes and the ancient hat which convention makes us reluctantly discard.

The breaking-in process—the abolishing of friction by means of friction—is a necessary incident in the life of all machinery. Kipling has wonderfully described this process of conflict and adjustment as applied to inanimate things in his story "The Ship Which Found Itself":

"Oh, she's no so bad," the skipper replied cautiously. "But I'm sayin' that it takes more than christenin' to mak' a ship. In the nature o' things, Miss Frazier, if ye follow me, she's just irons and rivets and plates put into the form of a ship. She has to find herself yet."

"I thought Father said she was exceptionally well found."

"So she is," said the skipper, with a laugh. "But it's this way wi' ships, Miss Frazier. She's all here, but the parts of her have not learned to work together yet. They've had no chance."

"The engines are working beautifully. I can hear them."

"Yes, indeed. But there's more than engines to a ship. Every inch of her, ye'll understand, has to be livened up and made to work wi' its neighbour—sweetenin' her, we call it, technically."

"And how will you do it?" the girl asked.

"We can no more than drive and steer her and so forth; but if we have rough weather this trip—it's likely—she'll learn the rest by heart. For a ship, ye'll obsairve, Miss Frazier, is in no sense a reegid body closed at both ends. She's a highly complex structure o' various an' conflictin' strains, wi' tissues that must give an' tak' accordin' to her personal modulus of elasteecity." Mr. Buchanan, the chief engineer, was coming towards them. "I'm sayin' to Miss Frazier, here, that our little 'Dimbula' has to be sweetened yet, and nothin' but a gale will do it. How's all wi' your engines, Buck?"

"Well enough—true by plumb an' rule, o' course; but there's no spontaneeity yet." He turned to the girl. "Take my word, Miss Frazier, and maybe ye'll comprehend later; even after a pretty girl's christened a ship it does not follow that there's such a thing as a ship under the men that work her."

Some organizations are never properly "run in"; there are businesses which are well known for being in a constant condition of maladjustment, for being places of discord where changes are being everlastingly made and where the inevitable question which is asked when the latest superintendent or general manager arrives is "How long will he last?" Such concerns are not generally very great profit makers and the pertinent question which might also be asked is "How long will the business last when good men fight shy of risking their reputations by associating themselves with a concern notorious as a graveyard of careers."

The most important problem in connection with the development of an organization is undoubtedly the selection of a personnel of suitable calibre and capable of working as a har-

monious unit. Such an organization will "dig itself out" despite handicaps which would force a less capable organization to the wall. It does not, however, come within the province of this work to deal with this feature of the problems of organization even if the author felt he were capable of discussing this subject authoritatively, which he does not, but there is another problem in connection with the building up of an organization which is also of great importance and which forms the major theme of this chapter.

In order to render the policies of a business effective, to multiply its usefulness and to add to the tangible assets and good will of the business, in addition to the physical equipment requisite for production, distribution and administration the organization requires some kind of an established routine for performing the various operations necessary for the conduct of the business. Such a series of standard routine methods may properly be termed the "system" of a business.

An organization no matter how good its personnel may be fails to realize its full potential effectiveness if its routine methods are not properly formulated. Easy things become difficult if there is no standardized method of taking care of them and hard things are rendered harder. The most efficiently designed system will not make a weak organization strong, but it will render it more effective than it would otherwise be and though, as previously remarked, a strong organization will fight its way in spite of obstacles there is no question but that defective routine methods are a severe handicap to even the best of organizations.

It does not necessarily follow that a strong organization will inevitably develop really efficient methods of handling its routine work. Some successful businesses with which the author has been acquainted have achieved their success in spite of great defects in their systems, but this does not alter the fact that they would have accomplished more if their methods had been more efficient. The incompetency of its competitors is the salvation of many a business. Often the successful ones are successful not because they have been highly efficient but because they have been less inefficient than others. Let us take a concrete instance—that of cost accounting with which this volume deals. It may be stated that many a concern whose name is a household word does not know what its goods cost to make, or on what lines its profits are realized. Considered from the standpoint of furnishing the manufacturer with information relative to

operating efficiencies and there is probably not one cost system in a hundred which may be considered to meet reasonable requirements.

Unfortunately the word "system" is associated in the minds of many with the memory of unsatisfactory experiments conducted in its name by those who have confused external details with fundamental principles and because, for instance, in applying the principles of system it has been found convenient and expedient to use standard printed forms have endeavored to obtain results merely by introducing a multiplicity of printed forms without possessing a knowledge of underlying principles.

The dangerous tendency of the half-educated and superficial thinker is to lose his bearings in a sea of detail, and to mistake surface variations for basic principles. The liability to lose sight of the essential unity of things is very evident in many offices where there is a marked tendency to imagine that if the most approved mechanical devices are employed the office cannot fail to realize a high degree of effectiveness.

Printed forms and mechanical devices such as adding machines, duplicating, calculating, sorting, billing, tabulating and time-recording machines have their place and are of great value, but an office may be equipped with all of these and yet if the methods employed are not founded upon correct principles satisfactory results will not be obtained.

No one is more fully wedded to the principles of scientific management than the author or has a greater appreciation of the sterling value of what has been accomplished by the real thinkers and workers in this field, but when he considers some of the things which have been done by the type of gentleman who imagines that the purchase of a stop watch and a hurried reading of Mr. Knoeppel's "Installing Efficiency Methods" is all that is required to be fully equipped to render adequate service in the industrial field, he is inclined to paraphrase a well-known saying and exclaim, "Oh Frederick Taylor, in thy name what sins have been committed!"

The efficiency expert was not very active in Great Britain in the days when H. G. Wells wrote his story "Kipps" in 1905, but Mr. Wells' description in this story of the "fishent" Shalford seems strangely reminiscent of one type of "expert" some of us have known:

> Emerging in the shop again among a litter of toys and what are called "fancy articles" Shalford withdrew a hand from beneath his coat-tails to indicate an overhead change carrier. He entered into elaborate calculations

to show how many minutes in one year were saved thereby and lost himself among the figures—"Seven times eight seven nine—was it? or seven eight nine? Now, *now*—Why when I was a boy your age I c'd do a sum like that as soon as hear it—We'll soon get yer into better shape than that. Make you Fishent. Well y'r must take my word, it comes to pounds and pounds saved in a year—pounds and pounds—System! System everywhere, Fishency.

They passed into a yard and Mr. Shalford waved his hand to his three delivery vans all striped green and yellow—"Uniform—green, yell'r—System." All over the premises were pinned absurd little cards: "This door locked after 7:30—By order Edwin Shalford," and the like.

He never stipulated for so many months' credit but bought in November "as Jan." It was not only words he abbreviated in his London communications. In paying his wholesalers his "system" admitted of constant error in discount of a penny or twopence, and it "ficilitated business" he alleged, to ignore odd pence in the cheques he wrote. His Ledger Clerk was so struck with the beauty of this part of the system that he started a private one on his own account with the stamp box that never came to Shalford's knowledge.

The spirit of the old proverb "give a dog an ill name and hang him" applies to words as well as canines, but unfortunately we cannot find substitutes for discarded words as easily as we can replenish our kennels, and as there is no other word which so satisfactorily conveys the same idea as that of "system" the paucity of our language renders it necessary to retain it in our vocabulary. Under these conditions the best course to follow is to clear its character of the false impressions which have become associated with it by determining its true meaning. "System" in a standard dictionary is defined as being: A whole plan or scheme, consisting of many parts connected in such a manner as to create a chain of mutual dependencies. Obviously under this definition we live in a world of systems and of systems within systems, the universe as a whole being one immense system embracing incalculable billions and billions of minor systems from that of the system of which our sun is the centre down to the respiratory system of a gnat dancing in that sun's declining rays.

In dealing with system therefore we are discussing no mean thing and in endeavoring to apply its basic principles in the operation of our business we are really engaged in an effort to bring the same into tune with the fundamental laws of nature.

Unity Underlying Systems

As an indication of the unity which we might expect to find underlying all systems, whether of philosophy, of business, or of the universe, it is interesting to note the close parallelism existing between the system of the human body and that of an established business. The development of the former has been the result of untold ages of experiment, of trial and error, and of the operation of the inexorable law of the survival of the fittest, and yet in many respects man has instinctively adopted the methods of the body in the solution of the complex business problems which have been the growth of the last few hundred years and mainly of the last few decades.

One of the most difficult and complex problems which required solution in the evolution of the human body was the finding of some means whereby a multitude of routine duties could be carried along without conflicting with the performance of operations calling for the exercise of the higher faculties. This problem was solved by the development of the nervous system, as to which Professor David Fraser Harris in his book entitled "Nerves" writes:

> Now it is very natural at this point to ask what exactly is the nervous system for. . . . It is first of all for carrying out certain activities, such as breathing, on a subconscious plane, *over which the constant supervision of consciousness would be tedious if it were not impossible considering the enormous number of demands made upon the attention of the individual. It is in the next place for carrying out certain activities with the greatest possible speed compatible with the greatest possible accuracy.*

Now, in the operation of a business we are confronted with a similar problem to that solved for the body by the development of the nervous system—namely, to find some means whereby an immense number of routine operations can be performed quickly, accurately, economically, and with a minimum of supervision on the part of the business executive. The solution of the problem in both cases has been practically identical, in the body the conscious mind has been relieved of an overwhelming burden by handing over routine duties to the nervous system, while, in the case of business, standard methods of performing routine duties have been devised and installed, in which methods the organization is so drilled that its performance of these is more or less automatic.

As regards the tremendous advantages realized by the body from its nervous system, Professor Harris states:

> Nerves and the nervous system not only protect the individual from injury enabling him to seek food, avoid or overcome enemies; *but they are constantly handing over some activity or other from the conscious to the subconscious realm.* . . . We educate the nervous system laboriously to perform certain actions, conscious attention being very much concerned in the acquisitions, but by degrees these acquisitions are relegated to the unconscious or at least subconscious realm and are at last carried on without the interposition of attention at all. *There is a very great saving of nerve energy here; things so done are called habits.*

The first steps taken by a child call for the concentrated use of the conscious mind but after the method of walking has been firmly established the nervous system takes over this function and most of the time that the adult is walking he is hardly even conscious of the fact. The first time we ride on a bicycle there is a desperate trial of our conscious faculties, but after the habit has been acquired the business becomes entirely mechanical, so much so in fact that in long distance bicycle races the rider has been known to ride while asleep. More than once was it noticed by the men in the boat that the cross-channel swimmer Holbein was asleep though still swimming, and we are all familiar with the absent-minded way in which when interested in a conversation at the table we help ourselves to the sugar without losing for one moment the thread of the conversation.

One of the most remarkable instances on record of the automatic functioning of the mind is that embodied in an anecdote related by Mr. Edison and which appears in one of his biographies as follows:

> I noticed an immense crowd gathering in the street outside a newspaper office. I called the attention of the other operators to the crowd, and we sent a messenger boy to find the cause of the excitement. He returned in a few minutes and shouted "Lincoln's shot." Instinctively the operators looked from one face to another to see which man had received the news. All faces were blank, and every man said he had not taken a word about the shooting. "Look over your files," said the boss to the man handling the press stuff. For a few minutes we waited in suspense, then one man held up a sheet of paper containing a short account of the shooting of the President. The operator had worked so mechanically that he had handled the news without the slightest knowledge of its significance.

In the days when the author was an articled clerk to a chartered accountant, it was the custom (and probably still is

tor while the English are a conservative people the English accountants are doubly so) for the accounting student to obtain his initiation into the mysteries of the accounting profession by spending many months in performing the most uninteresting routine work, probably 50 per cent of which was the checking of footings. This operation after a time became an absolutely automatic one, so much so in fact that when two articled clerks were occupied in this work they could engage in a rapid-fire conversation without in any degree neglecting their work or slackening its speed, in fact the author found that the less he concentrated on this work the more accurate he would be. In this country the adding machine has rendered the capacity to add figures rapidly and accurately a rare accomplishment and the author remembers an instance in one office when he found a young man who had written down on a slip of paper six items totalling less than a thousand dollars and climbed two flights of stairs to use an adding machine rather than perform the severe mental effort of adding them in his head!

Though on first consideration it may seem like an absurd waste of time, this severe drilling in monotonous routine work which the English accountant student has to go through, it has its advantages, for in addition to strengthening his faculty of concentration it also develops a kind of second sight, so much so that the thoroughly trained accountant when performing an investigation for fraud will often instinctively question an entry which on the face of it appears to be perfectly correct. At least the author found this to be the case in his own work along these lines and imagines that other accountants have had the same experience. As Dr. Frank Crane puts it:

> A human being is more than a mind. He is a complicated, amazing machine, a mysterious compound of spirit and matter. What he can do depends not only upon the thought of his brain but on the thoughts that have got themselves into his fingers, his eyes, his feet and his impulses. I may learn the rule of three out of a book so that I can say it backward, but I am not a good accountant until my spinal cord has learned it.

An important feature in connection with the more or less automatic functioning of the nervous system in carrying out routine operations is the fact that though this system is at all times ready to relieve the conscious mind of the necessity of performing routine operations, in so doing it will not vary one iota from the manner in which the performance was laid down by the conscious mind and it is to this peculiarity that we rightly attribute the importance of acquiring good habits.

However, as Ralph Waldo Emerson in his essay on "Compensation" stated: "Everything has two sides. Every advantage has its tax," and the individual who takes advantage of the benefits resulting from being able to relieve the conscious mind of the necessity of supervising the performance of routine duties cannot avoid the acceptance of the corresponding responsibility and of the danger of permitting the facility of the nervous system in this connection to result in the formation of bad habits.

Occasionally parents who desire their children to become skilled in the art of playing some musical instrument make the mistake at the outset of employing semi-skilled instructors to undertake the initial training of the child, to find in after years when they call upon a master in the art to "finish" the pupil's education, that the work already done has been worse than useless, more effort being required to break the old, bad habits than to acquire the new, right ones.

Bad Business Habits

Bad habits are as detrimental to a business as to an individual. Incorrect methods of performing routine work once firmly established cannot be corrected without a struggle. The path recommended may be far shorter than the one now followed, but to take it involves the trouble of blazing a new trail and of getting out of the old rut whereas to continue along the well-worn and familiar path is to follow the line of least resistance.

Unfortunately, in many cases it is not possible to adopt the ideal plan of carefully formulating our methods before we embark on our business venture and by this means acquiring good routine habits at the outset, though this plan has been followed successfully by some foresighted executives launching new undertakings on a fairly large scale. In the great majority of cases, however, the problem presented involves not only the determination of what the correct methods should be, but also the necessity of breaking away from established, defective routine before the improved methods can be introduced.

According to the definition previously given the idea of system is that of a number of interrelated and interdependent parts so connected as to form a complex whole and the attainment of perfection in this whole not only demands perfection in the individual parts, but also requires the attainment of the same

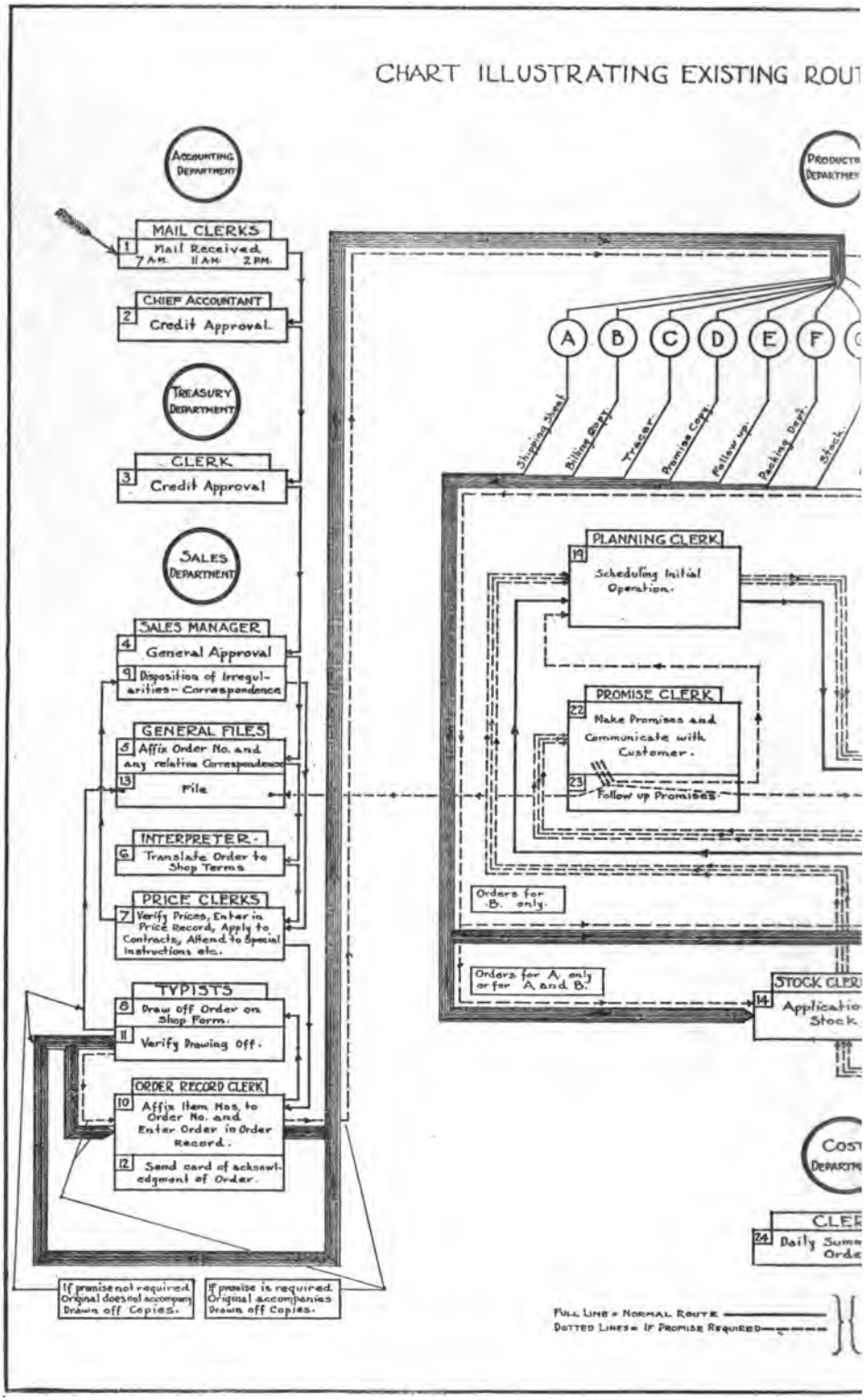

FIG. 4.—Diagram illustrating meth

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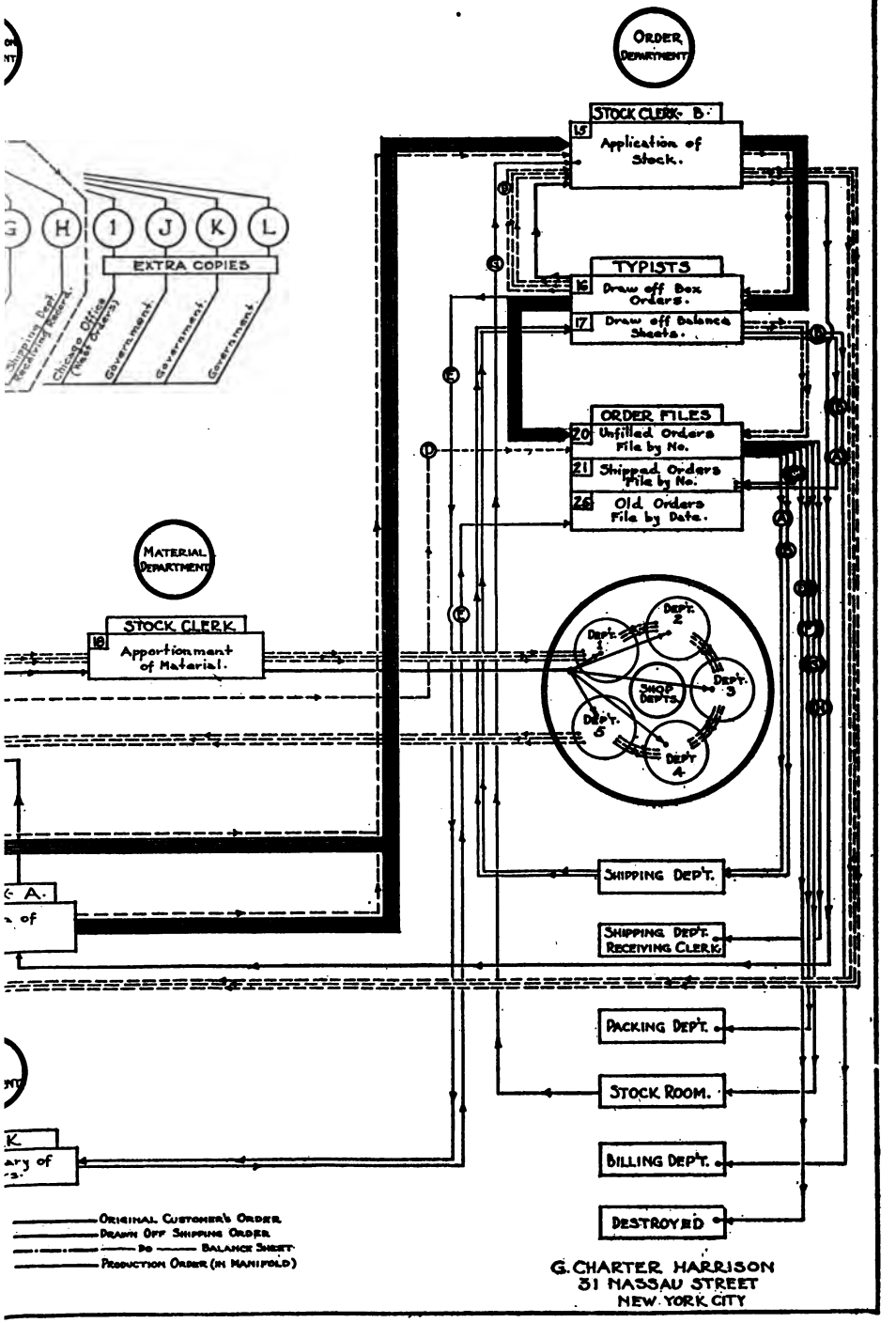


od of charting routine operations.

[To face page 77.

standard in the adjustment or balancing of the parts with one another. Broadly speaking, no business problems are strictly intradepartmental, what affects one department in some degree affects all the others. In the average business, however, this fact is in large measure overlooked and, due partly to the fact that each department is generally left to work out its own salvation unaided and partly owing to jealousy of any encroachment upon their particular domain, the department heads devise ways and means of meeting their own particular needs without much reference to how these methods conform to the requirements of related departments. Under these conditions such coördination as is realized is more the result of dire necessity than of a carefully thought out plan under which the interest of the business is paramount and that of the department or individual subordinate thereto.

Why Business Methods Fall Short

It is rarely in a large business that any person can be found who is able to completely recite the routine followed in the handling of an order from its receipt in the mail throughout all the intermediate operations up to the final shipping and billing of the material nor is it often found that any attempt has been made to analyze such routine with a view to eliminating duplication of work and overlapping of authority. Under such conditions it is hardly to be wondered that the methods employed fall far short of the ideal.

As an illustration of the ramifications involved in the modern manufacturing institution there is shown in Figure 4 a representation of the operations involved in the handling of an order in a concern where the requirements though complex are not by any means exceptional. A consideration of this diagram, which covers only a small section of the routine work of a large organization, will indicate how extremely difficult it would be for the average mind to visualize clearly the innumerable relations and operations involved in the conduct of modern business without the assistance of drawings illustrating these in complete detail. Unless the practice of machine design is followed and all the parts of the plan or scheme and their various interrelationships are clearly shown on paper it is practically impossible to determine where the routine employed involves duplication of authority and effort and working at cross-purposes, where

methods of check are defective or overlap and where essential requirements are overlooked and non-essentials introduced. Due to the absence of such diagrams, the conception in the mind of the average shop or office employee of the methods employed in the operation of a business outside of his own immediate duties is little more than a blur and this applies to the ordinary routine work of an office, to the methods of accounting employed and to the system of controlling the progress of work throughout the shops. It would be difficult to overestimate the educational value of a series of diagrams illustrating all of the routine of the business rendering it possible for every member of the organization to obtain an intelligent conception of the business as a whole and of the relationship of his particular work to the general plan.

Procedure in Planning Routine Work

In laying out any plan of routine work the logical procedure to be followed is to first clearly define the ends which it is desired to attain and then to determine the simplest and most effective means of realizing them. This statement would seem so obvious that it may be thought that this plan would be followed in a general way by every man of intelligence, but the author has come across cases where years have been spent in an endeavor to introduce satisfactory cost-finding methods by men who at no time have possessed anything more than the vaguest idea of what they were endeavoring to achieve. To minds like these the reverse of the logical procedure is followed; instead of laying down a general plan and then formulating the details to fit, they start out with small refinements here and there trusting ultimately, doubtless, to be able to coördinate these disconnected ideas in one grand plan. It is not by any means unusual to find cost accountants who have endeavored to develop such refinements of burden distribution that an attempt is made to apportion the cost of heat and light to departments and subdepartments, but who have overlooked such essentials as the control of raw material. The author knows of one case where a store accounting system was introduced under which it was necessary for one clerk to devote his entire time to keeping track of the cost of bolts, nuts, and screws which involved an expenditure of considerably less than his salary, and yet under this plan several hundred thousand dollars of other material was

shown on the books as being on hand when as a matter of fact it had been used in the manufacture of product shipped and billed months before.

There will continue to be wasted efforts in connection with cost accounting, such as have been described, until manufacturers generally obtain a better conception of the results they can legitimately demand of their cost accountants. The average manufacturer does not really know what information he should expect his accountant to furnish him, and as a rule his demands fall far short of what should be considered reasonable. Even such limited information as he calls for, however, cannot be furnished under the more generally accepted cost accounting methods, the limitations of which will be fully appreciated if the results obtained therefrom are considered in the light of the list of reasonable requirements of a cost system given in the first chapter of this volume.

Special Qualifications Needed to Design a Cost Accounting System

As soon, however, as the manufacturing world breaks away from the older idea of retrospective cost accounting and accepts the newer and broader conception of predetermined costs there will come a fuller appreciation of the dignity and importance of cost accounting. Instead of as at present expecting a more or less inexperienced cost clerk to work out his own salvation in the design of cost finding methods or calling for the assistance of professional accountants whose experience in the main has been confined to auditing and financial investigation work, the manufacturer of the future will undoubtedly employ the services of consulting cost experts not only experienced in the principles of accounting, but skilled in their application to meet the needs of the manufacturer. Sooner or later it will be generally realized that the designing end of cost accounting work calls for special qualifications not necessary for the operation of a cost system, and that only in very large institutions does it pay to retain as cost accountant a man with the extensive training and special ability necessary to design systems to meet the needs of the complex modern business machine.

The work of designing systems of cost accounting to meet modern industrial conditions demands a thorough training in the application of accounting principles which public accountants

are better able to obtain than accountants outside the profession, and this field of cost accounting would seem to offer attractive possibilities to this profession. Until professional accountants, however, realize that an extended experience in auditing and investigation work in itself is not sufficient to qualify a man to solve cost accounting and allied industrial problems, their efforts in this direction will continue to be unsatisfactory.

The Basic Features of a Simple Cost System

In the previous chapter there was illustrated a plan of standard or predetermined cost accounting to meet an exceedingly simple and in fact practically impossible situation in which the business of a manufacturer was confined to the making of a single size of machine bolt. The plan there submitted illustrated the general principles underlying the author's methods of using predetermined costs in connection with obtaining information as to manufacturing efficiencies, current costs and costs of sales.

Figure 5 is a diagram illustrating the basic features of a simple cost system to meet more complex conditions, the business taken as an example being one in which various kinds of machines of a standard character are manufactured involving the making and assembling of a large number of parts and the performance of several times as many operations. This plan has been drawn up to demonstrate that it is possible to design a system of standard or predetermined costs which will meet the most essential requirements, giving results not possible under the expensive and detailed retrospective cost systems and yet involving a minimum of clerical work both in the shops and the offices.

A plan such as is illustrated in Figure 5 is especially suitable for a concern where it is desired to obtain the essential cost information necessary for the proper operation of the business with the least possible disturbance and expense, leaving the development of the system as regards the production of refinements of information until some later time when the organization has been gradually educated to the point of demanding and being able to use such refinements of data as will be illustrated later.

An essential requirement of the retrospective cost systems in vogue is the obtaining of complete detailed distributions of the time of productive workers. If an operator is working on 15 or 20 different jobs during the day in order to be able to operate

the cost system, it is necessary to figure the elapsed time for every one of these operations. In some factories there is a serious loss of time owing to the necessity for men leaving their machines and taking a card to be stamped upon the completion of every job.

Under the author's methods of cost accounting the information that is considered of prime importance is that John Brown's pay this month was $76, whereas the standard value of the work he did was only $59. The question of the amount of time he spends on individual jobs is considered of relatively minor importance, the outstanding and dominant fact being that John Brown as a whole is not a profitable investment. Once predetermined costs have been figured for each operation, to ascertain the relation between John Brown's pay and the value of John Brown's production is a simple matter, all that is necessary being to obtain a list of the work that John Brown did, to price this out at the rates for such work included in the standard costs and to compare the total so obtained with the amount paid. In the illustration given in Figure 5, the accounting is along even simpler lines than this, the production for a whole department being figured at standard rates and compared with the direct payroll of the department. To extend the plan, however, to show individual labor efficiencies would be a simple matter.

The plan illustrated in Figure 5 will be considered briefly both from the standpoint of the results obtained and from that of the methods necessary. The results obtained from this plan are reflected in Forms K, L and M as follows:

Form K—Summarized Manufacturing Statement. The ability to bring to a focus on a single sheet of paper the essential facts relative to the trend of manufacturing costs is an outstanding feature of the methods of cost accounting which the author describes in this volume. In later chapters he will illustrate methods which greatly enhance the usefulness of the summarized manufacturing statement by analyzing by "causes" the various increases and decreases in cost, comparing actual with standard, but even the simple form shown in Figure 5 presents features which can hardly fail to interest the manufacturer of an exceedingly varied line of product who is accustomed to receiving the kind of cost statements emanating from the average cost department. Under the plan illustrated, instead of voluminous statements showing expenditures without relation to standards, and detailed schedules of the cost of the

machines completed during the month, the manufacturer has laid before him a statement which gives him a bird's-eye view of the situation. Such a statement will show him to what extent he has failed to realize his objective and will clearly indicate where to look for the trouble. It does not matter whether he is manufacturing a hundred different kinds of machines or whether the operations involved total to the tens of thousands, in this single statement rendered possible by the inexpensive and simple plan illustrated all of the manifold fluctuations in costs are brought to a focus so that the statement is as definite and clear as if instead of manufacturing a complex and varied product he were producing a single, elementary product such as Portland cement.

The faculty of being able to classify a myriad of facts and reduce them to a few simple statements is what distinguishes scientific methods from those of empiricism. Someone once very rightly stated that science is built up of facts as a house is built of stones, but that an accumulation of facts is no more a science than a heap of stones is a house, and the primary defect in the established methods of cost accounting is that instead of furnishing the executive with the completed edifice to which he should be entitled they present him with a heap of stones out of which he is expected to construct something of utility.

Ralph Waldo Emerson once remarked: "There is at the surface infinite variety of things; at the centre there is simplicity and unity of cause," and the causes underlying cost variations in businesses however dissimilar and diversified, are essentially the same. Cost accounting cannot be considered to be scientific until it recognizes this fact and provides the means for determining the basic and fundamental facts relative to the conduct of a business, and distinguishing these from a mass of inconsequential detail.

The summarized manufacturing statement illustrated in Figure 5 (Form K) provides a comparison between the actual and standard costs of all manufacturing operations for the month and for previous months. Increases are shown in red and decreases in black and all data analyzed under significant heads as follows:

(*a*) Material by classes
(*b*) Labor by departments
(*c*) Burden by departments and general expense.

Form L—Adjusted Cost of Sales and Profit and Loss Statement. This provides a comparison of the actual and standard cost of the goods shipped in the month, such costs being analyzed under the same arrangement as is provided on the summarized manufacturing statement.

Form M—Current Cost of Machine. This provides for obtaining the current cost of a machine by adjusting its standard cost to the basis of actual conditions by the use of the ratios of actual to standard cost of the various classes of material, labor and burden as appearing on the summarized manufacturing statement.

To obtain the information enumerated above, it is necessary:

1 For predetermined costs to be compiled of all manufacturing operations undertaken, the classification of such cost data conforming to that used on Forms K, L, and M—namely:

(*a*) Material by classes.
(*b*) Labor by departments.
(*c*) Burden by departments and general expense.

The method followed in compiling the standard or predetermined costs is illustrated in Forms A, B, and C.

2 To provide means for obtaining the standard cost of all work done arranged under the classification followed in the compilation of the standard costs and in the summarized manufacturing statement. This medium is provided in the monthly summarized production report (Form D). In this form the work produced in a department is extended at the labor and material rates as appearing on the standard costs.

3 To provide accounts in which to summarize the information collected relative to the actual and standard cost of the various classes of material, labor, and burden. This requirement is met by the inventory accounts—Forms E, F, G, and H.

4 To provide a medium for extending shipments at standard cost. This is furnished by Form J.

Figuring Standard Costs of Material

The figuring of standard costs is comparatively simple when the uses to which such costs are to be put are known. For instance, one of the important advantages of standard costs is that by their use the cost of material in a machine, no matter when the cost was compiled, can be adjusted with facility to the basis of current conditions. In the case of the windstacker cost shown in Form C on Figure 5 it will be seen that the total standard cost of the lumber in the many parts of which this machine is comprised totals to $15.43. In obtaining the current cost of the lumber in this machine (Form M) by the use of the ratio of 116.7 per cent of the actual to standard cost of lumber, obtainable from the lumber work in process account (Form F), we obtain a current cost of lumber in the windstacker of $18.01.

In compiling standard material costs the following rules should be remembered:

1 Material should always be figured in standard costs at the same price.

2 The material classification adopted should be sufficiently detailed to provide for the ratio of actual to standard cost for a material class, as shown by the inventory accounts, representing approximately the ratio between the actual and standard cost of the material in that class for each important item of product.

As regards the first of the above rules, assuming that forgings, for instance, are purchased on a flat price per pound basis—it matters little from the standpoint of obtaining current costs of the forgings in a machine whether the standard price of forgings is taken as 10 cents per pound or 50 cents per pound, so long as forgings are always figured in standard costs at the same price per pound. For instance, suppose that in Machine A there are 50 pounds of forgings and in Machine B there are 75 pounds, on the basis of a standard forgings cost of 10 cents per pound the standard cost of the forgings in Machines A and B will be $5 and $7.50, respectively, and on the basis of 50 cents per pound $25 and $37.50, respectively. Assuming that the actual cost of forgings is 15 cents per pound, then the comparison between actual and standard cost would appear on

the records as shown by Table 7. And using the ratios given in Table 7 in adjusting the standard cost of forgings to the basis of current conditions gives identical results as shown in Table 8.

TABLE 7. ACTUAL VS. STANDARD COST OF FORGINGS

Pounds	Actual Cost		Standard Cost		Ratio $\frac{\text{Actual}}{\text{Standard}}$
	Per Pound	Total	Per Pound	Total	Per Cent
5,000	$0.15	$750	$0.10	$500	150
5,000	0.15	750	0.50	2500	30

TABLE 8. ADJUSTED STANDARD COSTS OF FORGINGS

Machine	Standard Cost of Forgings		Ratio $\frac{\text{Actual}}{\text{Standard}}$	Adjusted Cost
	Per Pound	Total	Per Cent	
A.....	10	$ 5.00	150	$ 7.50
B.....	10	7.50	150	11.25
A.....	50	25.00	30	7.50
B.....	50	37.50	30	11.25

The extent of refinement necessary in the classification of material costs depends very largely upon the character and variety of product manufactured. In some cases where approximately the same proportions of the different classes of material would be used in all the machines manufactured it would probably be found that approximately correct results would be obtained if all material were carried in one account and an average ratio of actual to standard obtained. On the other hand, it may be necessary to introduce considerable refinements in the classification, for instance, where in a small size machine the steel used might be practically entirely of base price stock while in a large machine it might be mainly of material with "extras." In view of the fact that the base price of materials is constantly fluctuating while the extras are rarely

changed it follows that the use of one adjustment factor to cover variations in the cost of the material as a whole will result in an increase in the base price of material causing an overcharge to the machine using extras and a corresponding undercharge to the machine using base price material. For instance, suppose the standard base price of the steel to be, say, $2 and in the large machine all of the steel used to take an extra of 20 cents, the standard cost of the steel in these machines would be as shown in Table 9:

TABLE 9. STANDARD COST OF STEEL FOR MACHINES

Machine Size	Base			Extras		
	Pounds	Price per 100 Pounds	Amount	Pounds	Price per 100 Pounds	Amount
Small.....	500	$2.00	$10.00	.....	.....	.....
Large.....	1000	2.00	20.00	1000	$0.20	$2.00

Assuming that the purchases during the period under review totalled 50,000 pounds at a base price of $3, 25,000 pounds of which represented extra price stock, a comparison of actual to standard would be as shown in Table 10. The adjusted cost

TABLE 10. COMPARISON OF ACTUAL AND STANDARD COSTS OF MACHINES

	Base	Extras	Total
Pounds.....	50,000	25,000	.....
Actual Cost:			
Per 100 pounds.....	$3.00	$0.20	.....
Total.....	$1,500.00	$50.00	$1,550.00
Standard Cost:			
Per 100 pounds.....	$2.00	$0.20	.....
Total.....	$1,000.00	$50.00	$1,050.00
Ratio, actual to standard, per cent...	150	100	147

of the steel in the two machines, assuming that no distinction had been made in the accounting for base and extras, would then be as shown by Table 11. If, however, a distinction had

TABLE 11. ADJUSTED STANDARD COST OF MACHINES

Machine Size	Standard Cost of Machine	Ratio $\frac{\text{Actual}}{\text{Standard}}$ per cent	Adjusted Cost
Small	$10.00	147	$14.70
Large	22.00	147	32.34

been made in the accounting as regards base and extras the adjusted steel costs would be as shown by Table 12. So that,

TABLE 12. ADJUSTED STANDARD COST OF MACHINES—BASE AND EXTRA COSTS GIVEN SEPARATELY

Machine Size	Base			Extras	Total
	Standard Cost	Ratio $\frac{\text{Actual}}{\text{Standard}}$ Per Cent	Adjusted Cost		
Small	$10.00	150	$15.00	.....	$15.00
Large	20.00	150	30.00	$2.00	32.00

as was previously stated, unless the classification provides for distinguishing between base and extras, an increase in price would tend to undercharge the machine not using extras at the expense of the machine using extras.

In actual practice it will rarely be found that this refinement in classification is necessary and as a general rule a classification of material under from 10 to 20 heads will meet all requirements.

Figuring Standard Costs of Labor and Burden

The ideal method of figuring standard labor costs is to apply the established methods of scientific management and make careful time studies for all operations, using the standard times so obtained as the basis of standard costs. In actual practice, however, it is not always feasible to follow this procedure, desirable as it may be, and this particularly applies to the undertakings with which the author is familiar where it is necessary within the period of a few months to install a complete system of standard costs for an extensive and elaborate line of product, such as for instance in the agricultural implement field where several hundreds of different styles, types, and sizes of machines are manufactured by one concern and in the silverware business where the number of different articles manufactured runs into the tens of thousands. In these cases if it were necessary to defer the installation of the cost system until scientifically determined standards were available for all operations years might be consumed in this undertaking and during this period the benefits derivable from the operation of a standard system of cost accounting would be largely absent. In such cases it is often the part of wisdom to take advantage of data already compiled by the existing cost system and to tentatively set the standard times on the basis of the records of past performance. This plan enables a system of standard costs to be installed with the utmost speed and many of the benefits derivable from such a system to be realized immediately, and as was noted in a previous chapter no particular difficulty is involved in substituting the scientific standards as these are determined for the original standards based on past results. Furthermore, the operation of a system of standard costs has remarkable educational value in developing the right viewpoint in an organization and the author calls to mind cases where his first suggestion that time studies should be made was received very coldly but after the cost system was in operation for a time and the suggestion again made it was adopted with enthusiasm.

One of the important advantages to be derived from the use of time standards in a complex industry even if these standards are based purely upon past results is that though comparisons between the actual and standard cost at any given time may not in themselves be of great significance, comparisons from month to month show unmistakably the trend of costs, bringing these

data to a focus in a manner not feasible under the usual systems of retrospective cost accounting. Assume the comparison between actual and standard time under such a plan for several months to be as follows:

	Actual Hours	Base Standard Hours
January	5000	4000
February	6642	5400
March	5310	4500
April	5969	4700
May	5324	4400

Now if it is desired to show the efficiency of labor in the months of February to May, with that existing in the month of January, all that is necessary is to adjust the standard for the former months to the January actual basis by using the ratio of actual to standard for that month. Thus the actual hours of 5000 in January represent 125 per cent of the standard hours of 4000 and using this factor of 125 per cent for the standard of the other months gives the following comparisons with the January efficiency:

	Hours	Adjusted Standard Hours	Increase	Decrease
January	5000	5000		
February	6642	6750		108
March	5310	5625		315
April	5969	5875	94	
May	5324	5500		176

It should be understood that the author does not recommend the use of standards of past performance except as a temporary but nevertheless valuable expedient and in fact as was stated in the previous chapter he considers that such systems as that of Mr. Leitch's, which are founded entirely on a comparison of present with past results are unsound.

When speed is of extreme importance in the introduction of cost methods, and often it is of vital importance, the most satisfactory results can be obtained by the use of past results coupled with a series of assays or tests for the purpose of determining the average efficiency in the different departments and operations. If the observations made are sufficiently extensive and representative, the law of averages may be relied upon to give

approximate correct results and reliable efficiency statements compiled without requiring the making of time studies for more than a fraction of the operations involved in the conduct of the business. The method of adjusting the past results to the basis of 100 per cent efficiency is similar to that just described for making comparisons of the showings of different months with one another and may be illustrated as follows:

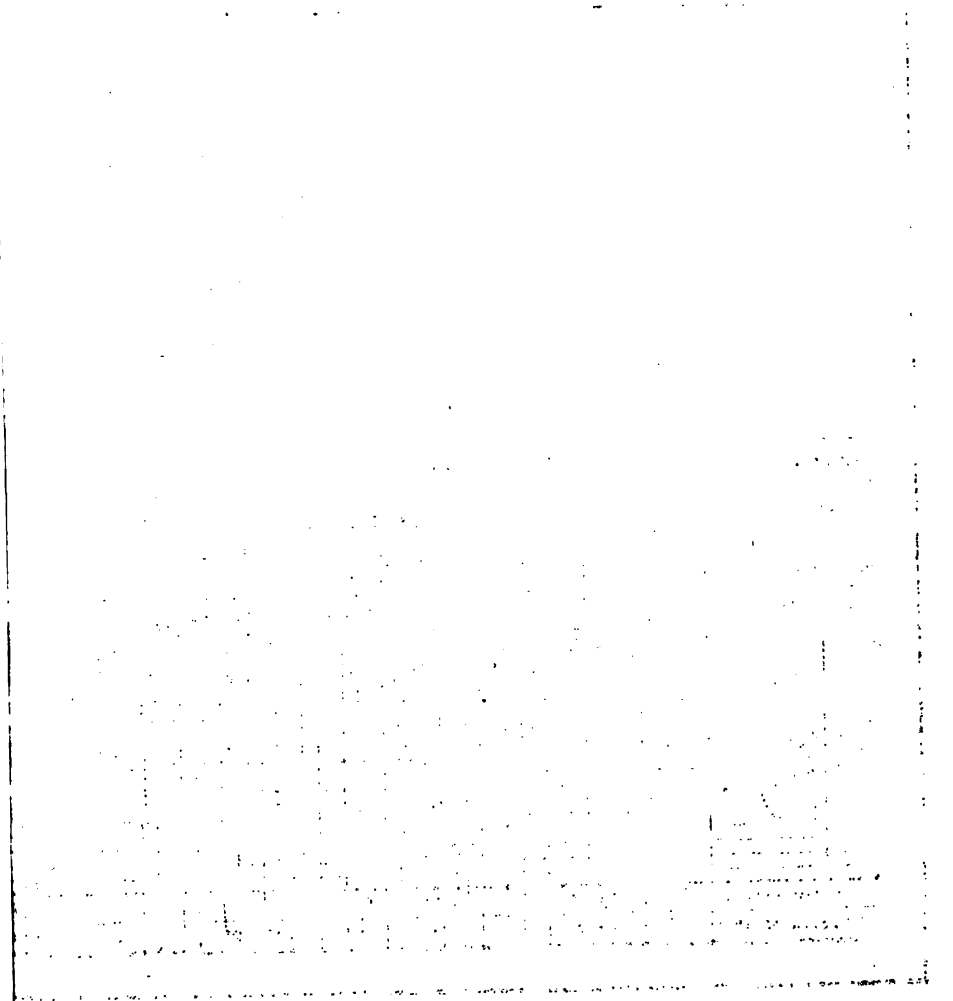
Assume that a series of assays or tests shows that the average efficiency of a machine shop is 79 per cent, and that reliable records of past results have been used for the purpose of figuring base standards. Assume further that the comparison of actual hours with base standards for a given month is as follows:

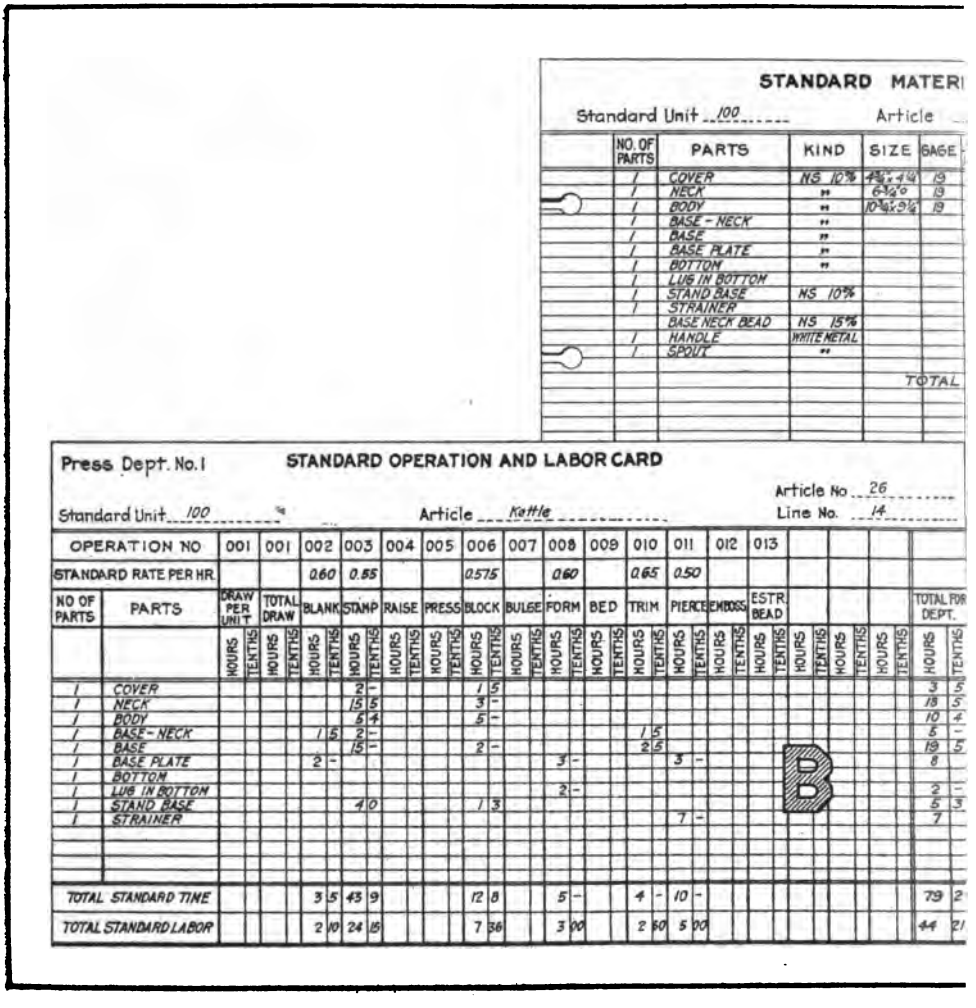
Actual hours	7600
Base standard hours figured on past results	7980
Current efficiency, per cent, using past results as standard	105

The actual efficiency of the machine shop for the month is only 82.95 per cent, made up as follows:

Standard hours, based on past results	7980
Average efficiency, per cent of machine shop comparing 100 per cent standards with past results	79
100 per cent standard hours produced in month 7980×79 per cent	6304.2
Actual efficiency per cent: $\frac{6304.2}{7600}$	82.95

In Figure 6 is illustrated the method followed in figuring standard costs in a business where a large variety of hollow silverware is manufactured. The example shown in the illustration is that of a kettle which comprises a number of different parts made of various kinds of material and involving the performance of numerous operations. The method of figuring the standard labor for one department, namely the press department, is illustrated in Form B (standard operation and labor card). On this form provision is made for showing the standard times (in hours and tenths) for the different operations on the various parts, the time for each operation on all of the parts in total being figured at the standard rate per hour for each operation, and the grand total of the hours and standard labor cost for





STANDARD MATERI

Standard Unit 100 Article

	NO. OF PARTS	PARTS	KIND	SIZE	GAGE
	1	COVER	NS 10%	4¾ x 4¼	19
	1	NECK	"	6½ø	19
	1	BODY	"	10¾ x 9¼	19
	1	BASE - NECK	"		
	1	BASE	"		
	1	BASE PLATE	"		
	1	BOTTOM	"		
	1	LUG IN BOTTOM			
	1	STAND BASE	NS 10%		
	1	STRAINER			
		BASE NECK BEAD	NS 15%		
	1	HANDLE	WHITE METAL		
	1	SPOUT	"		
					TOTAL

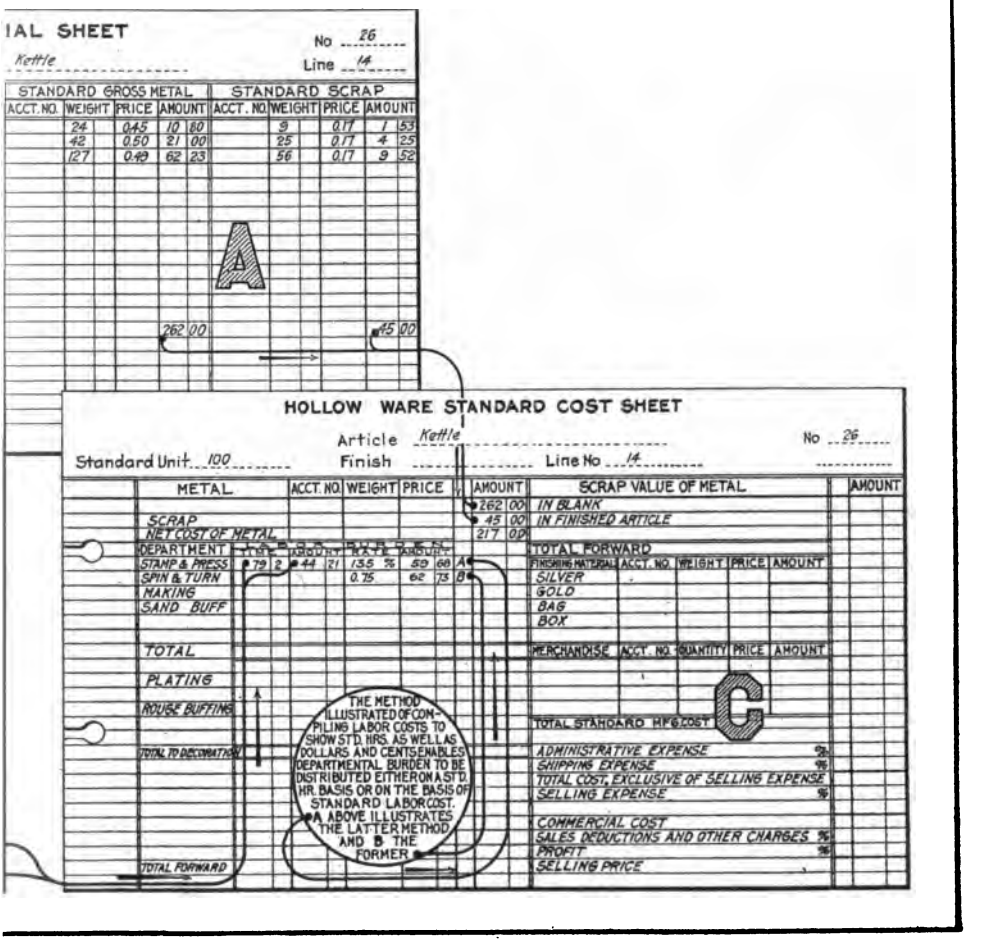
Press Dept. No. 1 **STANDARD OPERATION AND LABOR CARD**

Article No. 26

Standard Unit 100 Article Kettle Line No. 14

OPERATION NO		001	001	002	003	004	005	006	007	008	009	010	011	012	013					TOTAL FOR DEPT.	
STANDARD RATE PER HR.				0.60	0.55			0.575		0.60		0.65	0.50								
NO OF PARTS	PARTS	DRAW PER UNIT	TOTAL DRAW	BLANK	STAMP	RAISE	PRESS	BLOCK	BULGE	FORM	BED	TRIM	PIERCE	EMBOSS	ESTR. BEAD						
		HOURS TENTHS	HOURS TENTHS	HOURS TENTHS	HOURS TENTHS	HOURS TENTHS	HOURS TENTHS	HOURS TENTHS	HOURS TENTHS	HOURS TENTHS	HOURS TENTHS	HOURS TENTHS	HOURS TENTHS	HOURS TENTHS	HOURS TENTHS	HOURS TENTHS	HOURS TENTHS	HOURS TENTHS	HOURS TENTHS	HOURS	TENTHS
1	COVER				2 1			1 5												3	5
1	NECK				1 5 5			3 1 1												18	5
1	BODY				6 4			5 1												10	4
1	BASE-NECK			1 5	2 1							1 5								5	1
1	BASE				1 5 1			2 1				2 5								19	5
1	BASE PLATE			2 -						3 -			3 -							8	
1	BOTTOM																				
1	LUG IN BOTTOM									2 -										2	1
1	STAND BASE				4 0			1 3												5	3
1	STRAINER												7 -							7	
	TOTAL STANDARD TIME			3 5	43 9			12 8		5 -		4 -	10 -							79	2
	TOTAL STANDARD LABOR			2 10	24 15			7 38		3 00		2 60	5 00							44	21

FIG. 6.—Illustrating method of figuri



ıg standard cost of a complex article.

[*To face page 90.*

the department being carried to the standard cost sheet (Form C).

The method of figuring the standard material is illustrated on the standard material sheet (Form A), sufficient detail being shown on this form to render further explanation unnecessary. The total standard material cost and the standard value of the scrap are posted from the standard material sheet to the standard cost sheet (Form C).

In designing the plan illustrated it was not thought necessary to introduce machine rates for the purpose of distributing burden to costs, the burden being analyzed by departments and distributed in proportion to the standard labor. The total standard hours for the department as well as the amount of standard labor being posted to the standard cost sheet (Form C), the standard burden can be figured either as a standard per cent of the standard labor or as a standard rate per hour. Both methods are shown in the illustration on Form C as follows:

Method A		Method B	
Standard Percentage of Standard Labor		Standard Rate per Hour	
Standard labor	44.21	Standard hours	79.2
Standard burden rate, per cent	135	Standard rate per hour..	0.75
Standard burden	59.68	Standard burden	62.73

In certain classes of business the distribution of burden departmentally in proportion to the standard hours or the standard labor meets all practical requirements but this method in other cases will give results which are seriously inaccurate, an illustration being given in the previous chapter of a case where the distribution of burden on a departmental basis resulted in one class of work being charged with ten and a half times as much burden as it should properly have borne. Under such conditions it is necessary to introduce a system of machine rates, the advantages and possibilities of which will form the subject matter of the succeeding chapter.

Chapter IV

THE PRINCIPLES OF BURDEN DISTRIBUTION

THE successful solution of cost accounting problems demands the exercise in large measure of the faculty of judgment, for it requires the ability to visualize the numerous factors involved in their proper perspective and to adopt the plan in which the benefits to be gained most outweigh the disadvantages.

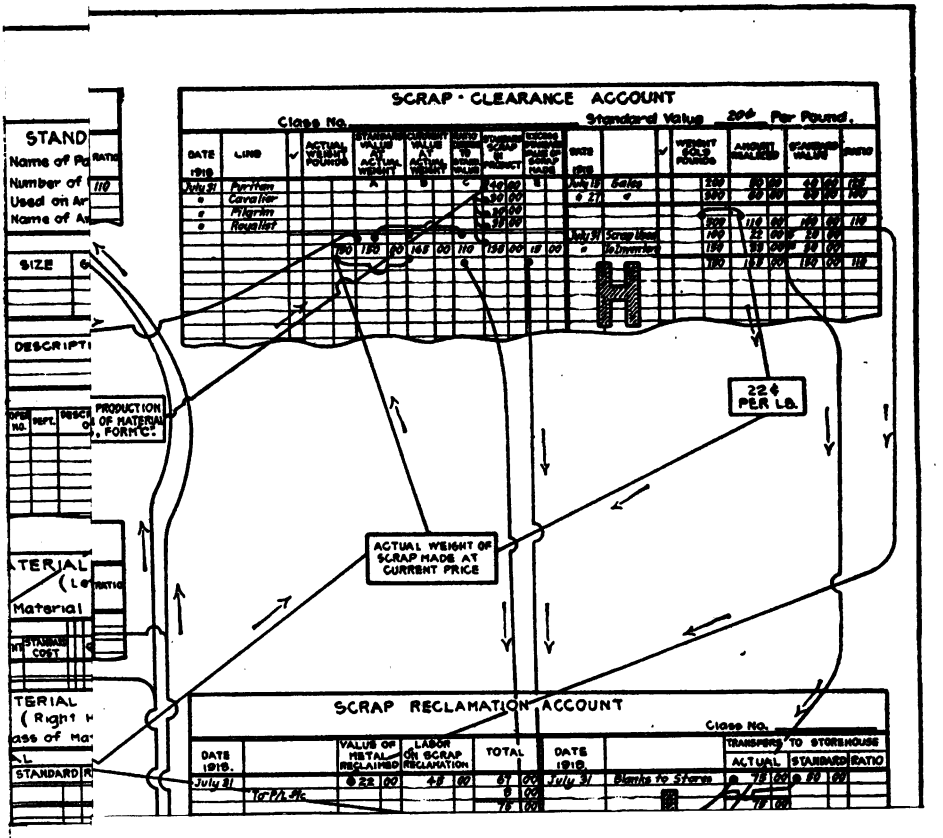
In passing judgment as to which is the best system of cost accounting to meet any situation it is necessary to weigh carefully the importance of the various elements involved, to decide for instance whether a limitation of the scope of the information with a resultant decrease in the expense of operating the plan is desirable or not, or whether the benefits to be derived from an increased refinement in the methods of burden distribution will more than offset the delay in the preparation of monthly statements occasioned by this change.

The system most suitable to meet the needs of a business will invariably be found to be more or less of a compromise. In cost accounting, the law of compensation applies—what we gain in one place we lose in another; what we save by employing incompetent and inaccurate clerks we lose from the errors they make, and what we gain in speed in the compilation of information we pay for by limitations in its scope.

In Figure 7 is illustrated a plan in which the advantages to be derived from simplicity in design were deliberately sacrificed in order to obtain more important benefits. The problem solved in the plan illustrated may be briefly stated as follows:

The product manufactured was metalware of great variety marketed in different lines, the profit and loss on which it was necessary to show separately. Most of the articles made comprised a number of parts, different kinds and grades of material being used in making these parts. Scrap was salvaged from numerous operations all along the line.

It was necessary under the general plan employed to obtain a distribution of the material used and scrap salvages by lines of product and the problem was rendered particularly difficult as it by no means followed that the form of the material used as a basis in figuring the standard costs would be followed in actual practice. The standard cost, for instance, might be



figured on the assumption that a special cut shape would be used whereas if such a shape were not available a metal sheet might be used in place thereof.

Regarding this problem solely from the standpoint of simplicity of design, it is obvious that the plan to adopt would be to maintain records showing for each part manufactured the gross material used and the scrap produced in the various operations involved. Such a plan, however, would necessitate very numerous weighings of material and scrap and the material used being somewhat expensive these weighings, to get accurate results, would have to be made very carefully. In addition, a very great deal of clerical work would be necessary both in the office and the shop.

By the adoption of a plan exceedingly complicated in design (though simple enough in actual operation) it was rendered possible to obtain all results desired without necessitating the weighing of scrap from individual pieces. In such a case the complexity of design is of small moment if the adoption of a simple plan requires an immense amount of work on the part of the shop and office employees. Far too often unnecessary weighing operations are called for by cost accountants which result not only in retaining needless weighmasters on the payroll but are also a handicap to the business in slowing up production. Some weighing operations are worse than useless, an example of which is the weighing of such scrap as turnings loaded with oil and dirt. Some thought given to devising methods of obtaining the results desired with one or more less weighing operations will often prove a profitable investment and as the plan illustrated in Figure 7 is applicable to meet a by no means uncommon situation a study of this diagram and the following description of the plan is recommended to those who are not entirely satisfied that their weighing expense is not unnecessarily high.

The Method of Obtaining Actual and Standard Material by Lines

Material will be divided into a few main classes arranged according to the general description of the material concerned. Each main class will be sub-divided according to a more detailed description covering gauge, size and shape. Two sets of accounts will be maintained, viz.: the controlling accounts which will

relate to the main classes only, and be carried in both standard and actual figures, and the detail or material accounts which will be carried in quantities only, the latter being maintained by the storekeeper for his own guidance and to prove controls.

The purchase records of the general books will be designed in such a manner as to provide an analysis of material purchases by main classes and the periodical totals of these analyses will be recorded in the material controlling accounts (Form B) under the main caption of received, and sub-captions of quantity and actual cost. The standard value under the main caption of received will be obtained by multiplying the quantity received by the cost. Standard material values will be established at a figure which will include freight and in compiling the purchase records in the general books the freight will be extended to the column of the analysis relating to the particular class of material in respect to which it was incurred.

The material requisition card (Form C) has been designed to provide the following information:

1 Material account number which indicates both class and account numbers
2 Actual weight issued
3 Standard cost of material issued
4 Standard cost of material in product
5 Line of product
6 Class of scrap
7 Standard value of scrap in production

As material is issued by the storekeeper the weight issued will be recorded on the material requisition card (Form C), the issues thereon being extended at the standard material cost per unit of weight. The units of product will be extended at the unit material and scrap values as shown on the standard cost of parts card (Form A). Monthly, or as often as may be desired, the cards will be sorted by class of material and the issues credited to the material controlling account at standard material cost, adjustment to actual being made by using the ratio between actual and standard shown on the received side of the record. The cards will be re-sorted by line of product and tabulation made of the standard cost of material issued and the standard cost of material in product. These figures will be posted to the debit of the work-in-process accounts for each line and the standard material costs adjusted to actual by using the ratio shown on the material controlling account. The

above process will provide the ratio between the standard cost of material in product and the actual value of the material used in manufacture.

Under the accounting plan here described, which is based upon the use of standards of material, quantity, and price, it is necessary, in order to be able to determine the efficiency realized in the use of material as also the material cost by lines, for the records to show the extent of the variations between standard and actual material cost. This problem is rendered particularly difficult as it by no means follows that the form of the material used as a basis for figuring standard costs will be followed in actual practice. For instance, the standard cost may be figured on the assumption that a cut shape will be used, whereas when a shape is not available a sheet may be used in place thereof.

The Method of Obtaining Actual and Standard Scrap by Line

No particular problem presents itself as regards recording the variation between standard and actual in the material issued but the difficulty which exists is as regards ascertaining the effect of the resultant variation in scrap comparing actual with standard as obviously it would not be possible except at great expense to figure the scrap produced on each order.

In the plan here presented a solution has been arrived at based upon the fact that an increase in material, owing to the material used being in different form to that contemplated in standard, will tend to result in a corresponding increase in the scrap which should be produced and vice versa. Accordingly the general plan here presented is as follows:

The material requisition card (Form C) is designed to show:

1. The standard cost of material issued (that is the actual weight issued extended at the standard price)
2. The standard cost of the standard material in the product (that is the standard weight extended at the standard price)
3. The standard value of the standard scrap to be salvaged from the product

Now obviously the difference between (1) and (2) represents the difference between the actual and standard weight of material

used extended at the standard price and is a direct index of the fluctuation in the quantity of material issued as compared with standard. Reverting to the statement above to the effect that an increase in material issue owing to a variation in the form of the material used as compared with standard will tend towards a corresponding increase in scrap production, it would follow that if the variations in scrap of each class are obtained in total an approximately correct distribution of this variation by lines of product can be made by distributing the variation to lines proportionately to the total variations of material quantities as obtained from (1) and (2) above.

Though this plan considered from the standpoint of the design of the system may be regarded as complex, it presents an exceedingly valuable feature as regards economy of operation of the system, for under this method scrap does not require to be weighed on the individual order, all that is necessary being to obtain the total production of each class of scrap periodically. This production can be figured either by periodically weighing the scrap produced or if preferred it can be obtained by taking into account the sales of scrap and figuring the inventory of scrap on hand at the close of the month.

The standard value of scrap in production will be obtained by sorting the material requisition cards (Form C) by scrap class numbers and tabulating the standard scrap production column. The total for each class of standard scrap will be charged to the "standard scrap in product" column of the appropriate scrap clearance account (Form H).

As previously stated, the actual scrap production will be obtained by weighing the production of each class of scrap produced periodically. Scrap produced will be valued on the basis of the amount realized from scrap sales.

Standard scrap production will be distributed to classes of product by sorting the material requisition cards by line numbers and tabulating the standard scrap production column. Variations between standard and actual scrap, as previously explained, will be distributed to product lines proportionately to the variations between the actual and standard quantities of material chargeable to the lines.

By the method here described for handling scrap transactions, calculations of scrap production are made on the basis of prices realized during the current period. Unsold balances of scrap will be carried to the scrap inventory account (Form K) and then sold, any profit or loss occasioned by the ultimate price

realized being under or over the price current at the time of the valuation of the production being carried direct to the profit and loss account.

Before it is possible to ascertain the amount of scrap that is to be transferred to the scrap inventory account, it will be necessary to credit the scrap clearance account with the actual and standard values of scrap used in production. The current price of scrap so used will be charged to the scrap reclamation account (Form J) where labor on reclamation will also be charged, thus making a total of scrap metal and labor on reclamation which represents the cost of producing blanks from scrap.

In as much as nearly all blanks are bought from the outside, it is proper to credit the scrap reclamation account with the value of such blanks at the price for which they are purchased on the outside, carrying any balance to the credit or debit of profit and loss account, as representing additional profit or loss to the profit or loss made in the regular course of operation.

The credit to scrap reclamation account for blanks made will be offset by a corresponding debit to the appropriate material account: in the latter account the entry in the actual column being the amount credited to scrap reclamation, the entry in the standard column being the regular standard cost of the blank.

Burden Distribution a Matter of Judgment

The exercise of the faculty of judgment is of particular importance when determining methods to be employed in connection with burden distribution. There is no one plan of distribution applicable to all classes of business, and refinements of distribution which in one case would be of the utmost importance in another would be absurd. For instance, in a business such as that of the manufacture of bolts and nuts where the cost of tools is very great and where high efficiency of operation depends very largely upon the wearing quality of tools, it is necessary that the system of cost accounting should provide complete data relative to tool costs and tool efficiencies. In some other lines of business tool cost is relatively unimportant. It can sometimes be safely merged in the machine rates and even as part of the departmental or general burden.

Probably more has been written on the subject of the treatment of burden in accounts than on any other phase of accounting, but with very few exceptions writers on this subject have

labored under the fundamental misconception of cost accounting which regards the province of a cost system to be absolutely limited to furnishing the means of distributing the expenses of a business as equitably as possible over its product. The result has been what might have been expected—like travelers on the wrong road, the more energetically they have proceeded along the line they have elected to follow the farther away they have strayed from their true destination.

In view of the fact that the primary and often the sole purpose of the usual elaborate systems of burden distribution is to enable correct information to be obtained as to the cost of the different products manufactured it is pertinent to inquire whether even this limited demand is really met by such systems. The author claims that when the system of burden distribution does not provide for distinguishing between the cost of production and the cost of idleness, which condition applies in the great majority of cases, however elaborate the refinements of burden distribution may be the results obtained are absolutely incorrect and misleading.

The absurdities of the usual methods of burden distribution are most evident, however, when the results obtained are considered from the standpoint of their value to the operating man. Under the wheel-within-wheel methods of burden distribution generally followed expenses are distributed and redistributed innumerable times—the result being that the final figures presented have no real significance and only by the most detailed and elaborate analysis can the elements of which any figure is comprised be determined. The elaborate systems of distribution defeat the purpose for which they were introduced—instead of clarifying the situation the farther they are carried to their logical conclusion the more they befog the issue so that finally a single figure on the cost statement represents an inextricable conglomeration of more or less irrelevant factors, and the figures mean little or nothing to anyone but the man who compiled them and even to him have little significance unless he first tears down into their component elements the figures which he has so painstakingly built up.

To take a concrete illustration, one of the hundreds of items on the cost sheet of a steel company would be the cost of locomotives in the open hearth and assuming that the usual methods of burden distribution are followed and that an increase in this item results in a demand for its analysis, it will be found that there are a great number of factors which may contribute to

the apparent increase shown which are in no way directly related to the work of the open hearth department or even the actual cost of operating the locomotives, the expense of which is included in the charge on the open hearth cost sheet. Some of the typical items which would contribute to the charge on the open hearth cost sheet would be the following:

Proportion of expense of mechanical department office
Overhead of shops doing repair work on tracks and locomotives which overheads would include such distributed factors as:
- Drinking water
- Light
- Electric power
- Mechanical department office expense
- Taxes
- Insurance
- Depreciation

Now each of the above items would be the result of other elaborate distributions and redistributions, as for instance;

Drinking Water:

This in addition to the direct charge for labor and repairs to pumps and wells, pipes, buildings, etc., would include such indirect charges as the cost of high-pressure steam (less low-pressure steam) electric power, taxes, depreciation, and shops overhead. Taking one of these subdivisions of the cost of drinking water—steam, for instance, and we would find that this also will have been affected by a multitude of factors, of which the following are examples:

Shops overhead, which of course has also been affected by the cost of the steam and of hundreds of other factors

The cost of locomotives, which account we are considering

The mechanical maintenance office, etc., etc.

Under such a system a simple, direct expense such as salaries paid to the clerks in the mechanical maintenance office would be distributed and redistributed a thousand times a month and it would be difficult to determine how much investigation would

be required to enable an accurate statement to be made of the final disposition on the cost sheets of this item.

Particularly unfortunate features of a method of cost distribution such as has been described above, which it may be incidentally mentioned is entirely in accordance with the principles laid down in standard works on cost accounting, are that it hides the true significance of really valuable information which has been compiled, involves considerable expense to perform and in addition delays the preparation of reports.

The usual complaint of the cost accountant is that the operating men do not sufficiently analyze the monthly statements which are prepared for their guidance, but when it is considered that no one other than the cost accountant himself is in a position to determine exactly how any particular item is made up and further that even for him this procedure involves a long and tedious process of analysis, it is difficult to understand how an operating man could be expected to make much headway in this direction even if he had the time available, which generally very properly he has not. Even more serious however is the fact that the cost figures are not shown in relation to standards, so that the operating man is compelled to compare the figures for this month with those of previous months, but even these comparisons are of little value for under such methods of distribution as have been described the fluctuations in any given item of cost may be dependent upon numerous factors having little or no relation to the item being considered.

The interpretation of cost statements would often be amusing if it were not so tragic, and in this connection the author calls to mind one case where a corporation with a large plant producing a main product with many by-products employed a firm of professional accountants to install a system of cost accounting involving the elaborate wheel-within-wheel methods of burden distribution such as have been described, and under which it is necessary to distribute some of the burden of the machine shop to the tool room and vice versa, and where the expenses of cleaning the office are carefully distributed to the operating departments, etc. The final result of these efforts was a series of cost sheets with thousands of items, each of which was reduced to varying unit costs taken to four places of decimals for this month, last month, this year to date and last year to date. To achieve this demanded the entire time and efforts of an experienced chief clerk and a considerable force of machine calculators and plant data gatherers, and the completed volume was seldom presented

to the officials of the company until well into the course of the next month and then was presented in person by the chief clerk who remained in the capacity of interpreter. He was quite resourceful at this and could explain, for example, to the perplexed official that the increase in the cost of operating the locomotive crane last month included an increase in the wages of the coal-handling gang, overtime in the machine shop, mishaps to the auto truck, severe breakage in the laboratory and an increase in the clerical force of the shop offices. The example given is exaggerated little if any and illustrates the danger of carrying refinements of burden distribution to a point where the results obtained become ridiculous.

In many cases, of course, in order to obtain correct cost information it is necessary to introduce very considerable refinements of burden distribution particularly in cases where the product is of a varied character and the work performed on a variety of machines. An illustration of the grossly inaccurate results sometimes obtained under the plan of distributing burden on a departmental basis was given in a previous chapter in which it was shown that under this method of distribution one class of work would be charged with ten and a half times as much burden as it should properly bear. In such cases, accurate costs can only be obtained by the use of machine rates and in Figure 8 are illustrated the underlying principles involved in such a plan of distribution.

The Underlying Principles of Machine Rates

A section of this diagram is devoted to illustrating the method of building up machine rates, and in the example given it is assumed that the rates taken are made up on the basis of past results, though obviously where an organization has developed to a point where standards of possible attainment can be figured in place of past performances such standards would be used. The method of building up the machine rates, however, would be similar to that shown.

Reference to the diagram will show that in the simple case taken as an example a machine rate comprises the following:

1 A standard rate per hour for machine repairs and maintenance
2 A standard rate per hour for power

3 A standard rate per hour for departmental burden (over and above machine maintenance and power)
4 A standard rate per hour for general factory expenses

The first two of these factors are common to the machines in a machine group (by which term is meant all machines in a department of identical character). The third is common to all machines in a department, and the last is common to all machines in the plant.

The portion of the machine rate for machine repairs and maintenance represents the cost per hour of maintaining the machines during the period taken as a basis. For instance, taking the second group of machines in Department A as an example, the machine hours in the period totalled to 4000 and involved an upkeep expense of $600, representing a rate per machine hour of $0.15, which figure is accordingly incorporated in the machine rate for that group of machines.

The units of power produced during the period taken as a basis totalled to 300,000, the cost of producing these being $30,000 or a cost per unit of $0.10. It is assumed that the consumption of power by the machines in group 2 of Department A is four units per hour, so that $0.40 is added to the machine rate in respect to this expense.

The burden (over and above productive labor, machine maintenance and power) of Department A in the period taken as a basis totalled to $5000, and the total of the machine hours in the department in this period was 20,000, representing a cost per machine hour of $0.25, this amount also being added to the machine rate.

General factory expenses, which are distributed over all the machines in the plant, totalled to $38,000, the total of the machine hours for the whole plant in the period being 200,000, or a cost per machine hour of $0.19.

The machine rate for group 2 in Department A totals therefore to $0.99, made up as follows:

Machine repairs and maintenance	$0.15
Power	0.40
Department A, departmental burden	0.25
General factory expenses	0.19
Total	0.99

In the standard cost sheet (Form A) is illustrated the method of using the machine rate in the compilation of a cost. In the operation shown as an example the standard time on a machine group per hundred pieces is taken as 10 hours, the machine cost being figured at 10 times the machine rate of $0.99 or $9.90 per hundred pieces.

The balance of the diagram illustrates the use of machine rates in connection with the compilation of efficiency data, this, as also the labor efficiency data illustrated, being obtained through the medium of punched cards and machine equipment for sorting and tabulating.

This use of punched cards for statistical purposes is probably well known to most of the readers of this volume, the method first being used in connection with the compilation of the census in Washington, and now very largely in industrial accounting. The principle involved is very simple, information being recorded on cards by punching holes in the manner illustrated in Form B on the diagram, information being obtained from the cards by the use of two machines, a sorting machine and a tabulating machine. The function of the sorting machine, as its name indicates, is to sort the cards in any arrangement desired. For instance, taking the card shown in Form B as an illustration and assuming that it is desired to arrange the cards by departments, the machine would be adjusted to sort the column headed c and the cards run through the sorter which would automatically (either mechanically or electrically, depending upon the system of machines employed) sort them by departments. The tabulating machine, as its name also suggests, is used in obtaining totals from the cards and is, in reality, an adding machine, the cards being run through the machine which registers the totals of the columns which it is desired to tabulate. For instance, continuing the illustration just given, after the cards were sorted by departments, by placing these cards in the tabulator the machine would automatically provide the totals of the following columns: actual hours worked; standard hours; standard machine earnings; standard labor; actual labor; actual hours at standard rate.

The outstanding advantage of the punched card method of compiling information is its extreme flexibility, for whereas in the case of compilation of written data any rearrangement of the information requires an entirely new written tabulation, by the use of punched cards any desired combination of information can be obtained merely by resorting and retabulating the cards.

The use of the punched card (Form B) in obtaining data relative to labor efficiencies is illustrated in Form C (analysis of standard labor earnings) this form showing the following for each group of machines:

1 Standard labor earned
2 Actual labor
3 Net increase or decrease
4 Actual hours figured at standard rate
5 Actual hours figured at actual rate (same as 2 duplicated on form in order to facilitate calculation of items in column 6, which represent difference between columns 4 and 5 as explained later)
6 Increase or decrease due to rate fluctuations
7 Increase due to variations in efficiency

The method of obtaining the information required in this form would be as follows:

1 Sort operation cards (Form B) by departments (column c)
2 Sort operation cards by machine groups (Column D)
3 Tabulate cards for each group as shown in Table 13

TABLE 13. STANDARD LABOR EARNINGS

Labor Earnings	Column on Operation Card (Form B)	Column on Analysis of Standard Labor Earnings (Form C)
Standard labor earned	*J*	1
Actual labor	*K*	2
Actual hours figured at standard rate	*L*	4

On Form C obviously the difference between the standard labor earned (column 1) and the actual labor (column 2) is the increase or decrease comparing actual with standard, and represents the index of the efficiency of labor as a whole, this difference being entered in column 3, increases being entered

in red and decreases in black, as indicated on the illustration. The difference between the actual hours figured at the standard rate (column 4) and the actual hours at the actual rate (column 5) represents the increases or decreases owing to changes from the standard rates, these differences being entered in column 6. The balance of the net increases or decreases that is the difference between columns 3 and 6, represents the increases or decreases resulting from variations in efficiency these differences being entered in the column so headed (column 7).

The operation card (Form B) also forms the medium through which the information required on the analysis of standard machine earnings (Form D) is obtained, the cards still arranged by machine groups being tabulated as shown by Table 14:

TABLE 14. STANDARD MACHINE EARNINGS

Machine Earnings	Columns on Operation Cards (Form B)	Columns on Analysis of Standard Machine Earnings (Form D)
Actual hours worked	*F*	2
Standard hours earned	*G*	4
Total standard machine earnings	*H*	8

The employment efficiency percentages in column 3 are obtained by dividing the standard working hours in period (column 1) by the actual hours worked (column 2). The operating efficiency percentages (column 5) are obtained by dividing the actual hours involved (column 2) into the standard hours earned (column 4) and the end efficiency (column 6) by dividing the standard hours earned (column 4) by the standard working hours in period (column 1).

The analysis of the total standard machine earnings (column 8) into standard repairs and maintenance of machines, power, departmental burden, and general factory expenses (columns 10, 12, 14, and 16) is obtained by using the components of the machine rates given in the section of the diagram illustrating the method of building up the machine rates; for example, taking the case of machine group 2 already referred to, the distribu-

tion of the total standard machine earnings of $370.26 is made up as shown in Table 15:

TABLE 15. DISTRIBUTION OF TOTAL STANDARD MACHINE EARNINGS

Item	Standard Machine Rates	
	Per Hour	Total
Repairs and maintenance	$0.15	$ 56.10
Power	0.40	149.60
Departmental burden	0.25	93.50
General factory expense	0.19	71.06
Total	$0.99	$370.26

The information obtained relative to standard machine repairs and maintenance, power, and departmental burden is carried to the departmental efficiency statement (Form G), where the total expenses are also shown, the latter being obtained from the distribution of store requisitions and indirect labor cards, as indicated on the diagram. The analysis of standard departmental miscellaneous expense and general factory expense is made in a similar manner to the analysis of machine repairs and maintenance and power, detailed data relative to this being shown in Forms E and F.

Information relative to efficiencies is brought to a focus in the summarized manufacturing cost and efficiency statement (Form H) this showing a comparison between the actual and standard costs of material, labor and burden of the whole plant. No details are shown in the diagram of the method employed for obtaining comparison between actual and standard material costs, this matter having been dealt with somewhat completely in the foregoing chapters.

There is nothing new in the use of machine rates as a medium of burden distribution but it is a somewhat remarkable fact that apparently the leading exponents of their use have not realized that in machine rates they have in their grasp the means of bringing cost accounting into line with modern industrial thought as expressed in scientific man-

agement methods. So completely has the accounting mind been obsessed by the idea that the sole object of cost accounting is to distribute expenses in such a manner as to obtain correct information as to the costs of manufacture that the fact that in machine rates we have the ideal vehicle for furnishing operating efficiency data does not seem to have been realized. A machine rate is a standard cost and a comparison of the machine earnings and the cost of operating the machines as illustrated in Figure 8 provides the simplest and most effective means of furnishing efficiency data. The advantage gained from the use of machine rates as a medium of expense distribution though important is not to be compared with that resulting from their use as a means of comparing the actual expense with standard.

Combining Standard Labor With Machine Rate

In the illustration given in Figure 8 the standard labor cost is figured independently of the machine cost but the ideal plan to follow when machine rates are used is to combine the standard labor with the machine rate. Once the machine rate is figured the work of compiling standard labor and burden costs is confined to determining the machines on which the various operations are performed and the standard production per hour for such work on the different machines. Assume, for instance, that the standard labor and machine rate per hour on a certain class of bolt header is $1.60 (labor $0.60, machine rate $1.00) and the standard production per hour for different classes of work on this machine to be as follows:

Countersunk machine bolts—½ inch diameter—2000 per hour
Plow bolts—7/16 inch diameter—2500 per hour

then the standard labor and burden cost per 1,000 of heading the two classes of product shown would be:

$$\text{Machine bolts } \frac{1.60 \times 1000}{2000} = 0.80$$

$$\text{Plow bolts } \frac{1.60 \times 1000}{2500} = 0.64$$

In order to determine the machine earnings all that is necessary would be to figure the production at the rates shown by Table 16:

TABLE 16. TOTAL MACHINE EARNINGS

Class of Product	Production	Rate per 1,000	Total Machine Earnings
Machine bolts	50,000	$0.80	$40.00
Plow bolts	75,000	0.64	48.00
Total	.....	.....	$88.00

Assuming that the machine rate of $1.00 per hour was made up as follows:

Power	$0.20
Tools	0.30
Repairs	0.15
Departmental burden	0.20
General burden	0.15
	$1.00

The distribution of the machine earnings would be made as shown in Table 17:

TABLE 17. DISTRIBUTION OF MACHINE EARNINGS

Item	Standard Rate per Hour	Per Cent of Total Machine Rate	Proportion of Machine Earnings
Producing labor	$0.60	37.5	$33.00
Power	0.20	12.5	11.00
Tools	0.30	18.75	16.50
Repairs	0.15	9.375	8.25
Departmental burden	0.20	12.5	11.00
General burden	0.15	9.375	8.25
Total	$1.60	100.00	$88.00

Combining this information with the actual expense of operating the machine and a profit and loss statement is obtained for the machine as shown by Table 18 which has real sig-

TABLE 18. MACHINE PROFIT OR LOSS

Item	Machine Earnings	Cost	Profit	Loss
Producing labor.....	$33.00	$35.00	.....	$2.00
Power.....	11.00	10.00	$1.00	.....
Tools.....	16.50	15.00	1.50	.....
Repairs.....	8.25	12.00	.....	3.75
Departmental burden..	11.00	12.00	.....	1.00
General burden.....	8.25	7.00	1.25	.....
Total.....	$88.00	$91.00	$3.75	$6.75
Net loss.....	.....	.....	.....	$3.00

nificance for the operating man. If the cost accountant can furnish the operating department with statements like this which do not demand laborious analysis and comparisons with previous months but show where costs have exceeded standard he will not have to complain that the operating men do not take sufficient interest in the figures which are submitted to them. In addition to showing the extent of variations from standard the plan should be expanded to show the "cause" of these variations, but this feature of the methods developed by the author is reserved for a later chapter.

Chapter V

COÖPERATION AND COÖRDINATION

THE predominant characteristics of the American people are extreme individuality, openness to new ideas, impulsiveness, energy, restlessness, and ambition. When the magnificent story of the material conquest of this land of opportunity is reviewed, the possession of these traits seems not only fitting but inevitable, for both ancestry and environment have joined in making the American of to-day what he is.

The inhabitants of the United States are the descendants of the most progressive and adventurous of the Europeans, of the Spanish, French, Dutch, British, Italians, Germans, Scandinavians, and Russians, who, breaking away from their own environment, embarked upon an adventurous journey to the land of promise.

None but the competent, the strong and the self-reliant could survive the hardships undergone by the early settlers; in the first terrible winter which the Pilgrims suffered nearly one-half of the entire number was cut off. As William Bradford, afterward Governor of New England writes:

> But it pleased God to visit us then, with death dayly, and with so general a disease that the living were scarce able to burie the dead, and the well not in any measure sufficient to tend the sick.

In 1607 George Percy, speaking of the colonists in Virginia writes that,

> Burning fevers destroyed them, some departed suddenly, but for the most part they died of mere famine. . . . Sufferers were groaning in every corner of the fort, most pitiful to hear, and if there were any conscience in men it would make their hearts to bleed to hear the pitiful murmurings and outcrys . . . some departing out of the world sometimes three and four in a night; in the morning their bodies trailed out of the cabins like dogs to be buried.

The hardships suffered by the early settlers—famine, fever, and the fierce, unrelenting struggle with land and forest and

the Indian foe, the tremendous tasks involved in the development in three centuries of a country not far short in point of area of the whole of Europe, have developed a race of people untrammelled by tradition, fearless, and tireless in endeavor and self-reliant in the extreme.

In the business world of to-day, we find in a marked degree the strong individualism which the American inherits from his hardy and self-reliant forefathers. It is a magnificent inheritance, this trait, and one which has made the American race leaders in the fields of invention and of business, but like all other human attributes there is a point where excess of development is a detriment rather than an advantage, and this applies particularly as regards individualism in the modern business organization where a large number of persons require to work together for a common end and for the common good, and where unless the interests of the individual are subordinated to those of the business organization as a whole there will be working at cross-purposes and consequent friction and waste.

Efficiency in the operation of a business is largely dependent upon two factors: *coöperation,* or the working together of the organization towards a common end; in other words team work, and *coördination,* or the arrangement of methods and instruments of production and distribution in such a manner that the business machine forms a harmonious whole, operating smoothly, continuously and effectively. American business however does not yet fully appreciate the importance of either coöperation or coördination, and the evidences of this are everywhere apparent. There is often too much of a tendency on the part of department heads to surround their departments with an imaginary line, outside of which they have little interest, and within which they resent intrusion.

In an earlier chapter the author mentioned an instance where the heads of the general accounting and cost accounting departments were so jealous of their authority that they issued separate cards of account, this procedure rendering it necessary for two entirely distinct expense and payroll distributions to be made—one for the general books and one for the cost records. Similar instances may be recited, and the reader can doubtless think of many more. Tremendous sums of money are lost owing to a lack of coöperation and coördination between the sales and distribution divisions of business. Some years ago, a certain automobile device was advertised extensively, and most expensively, but little provision was made to meet the demand

resulting from the advertising campaign, so that the money spent was in large measure wasted.

An Example of Cross Purposes

A leading publishing house some time ago in a full page advertisement in a magazine having a circulation among the particularly well-to-do offered an expensive set of books to be sent on approval to readers of that magazine. A friend of the author, a man of considerable means and extensive credit, wrote for these books to be sent him on approval. Some time afterward he received a printed postal card acknowledgment stating that the books would shortly be shipped. About three weeks later the books had not arrived and as he wished to give these to a member of his family as a birthday present, and as there was very little time left, he telegraphed at his own expense asking when the books would be shipped, stating that he wished to make a present of them and would appreciate prompt action. Several days afterward this concern wrote him advising that if he would furnish references they would be pleased to ship the books. When he wrote reviewing the history of the transaction and criticising the manner in which the affair had been conducted, particularly stating that he would have been glad to have furnished references had the necessity for this been mentioned in the advertisement or in the acknowledgment of his original request, his letter was never answered. Here is a case where the efforts and money expended by the advertising department were worse than wasted, owing to the incompetence and stupidity of other departments of the business.

In many manufacturing concerns the salesman makes the promises, having full authority to do so, but being without information relative to conditions in the factory, he leaves to the operating division the duty of explaining to the customer why the promises are not kept.

The relation between the average selling and operating organizations is one somewhat approximating a state of armed neutrality. Not being fully acquainted with one another's problems the members of one division are apt to attribute all troubles experienced to the deficiencies of the other. A particular source of irritation is the tendency of salesmen to accept orders for special product, when by the exercise of a little salesmanship it would be possible to supply the customer's wants with a

standard article and by this means save trouble for the operating division and expense to the customer.

Coöperation and the Average Office

The average office offers an excellent illustration of lack of coöperation. When the limited amount of assistance they offer one another is considered, one might imagine that the employees in adjoining departments were working for competing concerns instead of for the same institution. In all departments there are certain times when there is a peak load of work, in the payroll department, for instance, at the end of the week and in the accounting department at the beginning of the month, and there are also times when the work ahead is naturally very unequally distributed, for instance, when orders are few but shipments many, with resultant slackness in the order department and pressure in the billing and accounting departments. In many businesses, however, no attempt or very little is made to relieve pressure at one point by transfer of clerical help from a department where the work at the time is light. The argument that the employees in one department do not know the work of another department is simply evidence of a lack of training and planning, for the greater part of the work of all office departments is routine of such a character that if clear instructions were available any intelligent clerk could handle it with moderate supervision.

The author happens to be well acquainted with the methods of one large office in the middle west where several hundred clerks are employed and this concern has been able to very greatly reduce its clerical expenses by a centralization or coördination of the control of its office force, so that temporary pressure on one department can be equalized by transferring help from another department.

Such a plan of handling work affords a further advantage in furnishing greater possibilities for the advancement and development of members of the office organization. One of the most difficult problems confronting the manager of a large office is to find some way of enabling ambitious and capable subordinates to increase the value of their services both to their employers and themselves. In many cases there is no opportunity for advancement in the near future—the work of the immediate superior is satisfactory and other channels of promo-

tion are not available. By coördinating the work of the office employees, however, the versatile and capable employee can become very valuable and his capabilities along the lines of being able to handle a number of different jobs coupled with an elastic plan, so that advantage can be taken of this versatility, render it possible to pay larger salaries to the exceptional man than would otherwise be the case. In addition, the broader acquaintance which the employee obtains of the business generally enables him to handle the problems which he meets in his daily work more intelligently and with greater interest.

The Importance of Coördination in Accounting

The importance of coördination between the cost and general accounting systems has always been realized by professional accountants, but it is by no means unusual to find cost systems operated entirely independently of the general books and not controlled in any way by the latter, and the author calls to mind one instance when the dangers attending such a condition were somewhat vividly exemplified. In this case it was the custom to prepare a monthly statement of profit and loss. This statement was made up in two sections, it being the duty of the general accountant to set a valuation on the production of the factory for the month and of the cost accountant to make up a statement showing the cost of this production. These two sections of the statement were made up entirely independently, the excess of the value of the product over the cost of production representing the estimated profit for the month.

The operations of the business in question involved the production of an important by-product, the value of which represented a considerable proportion of the company's income and this by-product was treated by the cost accountant as a reduction of the cost of production and added by the general accountant to his valuation of the product, with the result that the profits as shown by the statement were inflated to the extent of this by-product, this being taken into account twice.

Very serious troubles have been caused by lack of coördination in accounting systems. The author knows of one case where an important company went into a receiver's hands, even though it was essentially in a sound condition, owing to having greatly overestimated its profits and declared a dividend which in fact had not been earned; in another case an important com-

pany made a similar error which might also have resulted disastrously.

The accounting system of a large concern manufacturing a varied and extensive product is necessarily complex, and unless the multitudinous records required are properly controlled and coördinated the most dangerous misinformation may be given out.

The Trend Toward Coöperation and Coordination

We are entering an era of coöperation and coördination, not only as regards the internal economy of the individual business but also as regards the relations between competitors in the same line and industry in general. This spirit is evidenced by the efforts which are being made in the different industries to establish uniform methods of accounting which will better conditions in the trade generally by eliminating indiscriminate price cutting, owing to a lack of knowledge as to costs of manufacture and distribution, and by encouraging the adoption of better business methods. It is beginning to be realized that business failures result not only in loss to the individual manufacturer, his employees, stockholders and creditors, but to his competitors in the loss of prestige sustained by the industry, and to the community in general, for in the long run it is the ultimate consumer who pays for everything. It is an understanding of this fact that prompted the Associated Advertising Clubs of the World to institute the valuable work undertaken by this organization in educating the retailer to keep proper records and adopt better methods of management.

Not only is there an increasing tendency toward coöperation between manufacturers in the same line, and between business men in general, but we may also look forward to an increasing degree of coöperation between the business interests of the country and the Government. The sound common sense of the people of this country will undoubtedly rebel against the extension of the paternalistic attitude so dear to a certain type of statesman and expressed in a desire to supervise, direct, and govern all of the activities of industry.

Public service corporations are beginning to realize that in the long run the way to profits lies along the line of coöperation with the consumer. The old "public be damned" policy is fast losing its adherents and though it is too much to hope that this

change of viewpoint has been entirely due to a change of heart, in recent years the majority of public service corporations have shown an almost pathetic desire to earn the good will of their customers.

The Balancing of Industrial Initiative and Organization Needs

One of the important problems in business is to determine the policy to be followed in order to encourage the exercise of individual initiative, and at the same time subordinate the individual to the interests of the organization and the business as a whole. In modern business, with the necessity which exists for the employment of specialists of many kinds, the maintenance of such a balance is an undertaking calling for skill and judgment. By the introduction, however, of properly designed routine methods the problem is greatly simplified, the work of all individuals being coördinated and part of a harmonious whole.

Even professional organizers often fall far short of fully applying this principle in management. This is particularly the case as regards the methods introduced in the planning and cost departments, in many cases the work of the former being entirely disconnected from that of the latter. Even in those cases where the methods of the planning department are founded upon the use of standards of time and production, the cost department will be operated along the lines of detailed cost accounting absolutely divorced and independent of the standards used by the planning department. Such a situation is obviously an absurdity. If the work of the shop can be predetermined and laid out according to standards of time and material, obviously the same standards can be employed in the cost department, the records of which will then reflect results in terms which are also common to those employed in the planning department. The author, however, cannot recall having seen any book or article on scientific management or accounting where a really complete coördinated planning and cost system is described.

As was previously stated, it is the province of the engineering department to determine standards and to provide the means of accomplishing them, while it is the function of the accounting department to furnish records showing the extent to which the standards are being realized and where the efforts of the engineering department have been successful and where not.

The Advantages of Coördinating Methods

The advantages of coördination in methods are many. Primarily, under such an arrangement the accounting and planning departments are speaking the same language which under the usual methods employed they certainly are not. Furthermore, coördination of these departments reduces very greatly the work in connection with the compilation of the basic data underlying costs and planning and also the cost of the routine work in connection with the operation of the system.

With this and the chapter following, there is given a series of diagrams which illustrate the principles underlying the operation of a coördinated planning, production, and cost system, a study of which it is believed will demonstrate the very material advantages accruing from the coördination of the work of the planning and cost departments. This plan is drawn up to meet the conditions existing in a concern manufacturing an extensive line of standard machinery—about as complex a condition as will ordinarily be met. Obviously, the plan is complicated and here again the author wishes to emphasize his contention that any really efficient plan to meet complex conditions must necessarily be complicated also.

As a matter of fact, most manufacturers who believe that the system they employ is a very simple one are under a delusion. The author calls to mind an instance when he presented to a department head a plan covering a suggested routine for handling a certain important division of the work of the latter's department. He was by no means prejudiced against the introduction of improvements, but he firmly but courteously rejected the plan when it was presented to him. Upon being asked the reason, he stated that it was "too complicated." Whereupon he was presented with another diagram with about twice as many forms as the other and three times as many operations and asked whether that looked any better. After he had emphatically stated that this second plan was far worse than the first presented the news was gently broken to him that the second plan was that which he was then operating, and from this point no difficulty was experienced in obtaining his enthusiastic support of the introduction of the new plan.

Some time ago, one of the author's assistants made a careful analysis in diagram form of the system employed by a progressive manufacturing concern, and in order to ensure that the

chart correctly illustrated the routine followed this was submitted to one of the officers of the company for his criticisms. This gentleman, after satisfying himself of the accuracy of the chart, stated that before this was drawn up he was under the impression that the system in force was an exceedingly simple one and that when he actually saw it on paper and realized how complex and elaborate it really was he nearly had heart failure.

To manufacturers who also believe that their methods are very simple the suggestion is made that they select some bright young man in their organization and instruct him to carefully chart the routine followed in connection with handling a customer's order from its receipt in the mail up to the billing and shipping of the goods and the determination of the profit or loss realized on the order. Make it clearly understood that every step must be illustrated. If the resultant chart is not quite elaborate and complex, either the business is abnormally simple, the bright young man a master in the skilful elimination of facts or the system far more efficient than any which it has been the author's privilege to pass upon.

It is somewhat surprising that in connection with one of the most complex things which the world has ever known, namely the modern business, manufacturers and business men generally should expect, or even hope, to attain extreme simplicity in methods. All simplicity possible, assuredly, but not simplicity obtained at the expense of inadequate results and unduly costly methods. The practical man realizes that he cannot expect to get simplicity beyond a certain point in the design of a high-grade automobile, an aeroplane, a locomotive, a battleship, or a submarine, and further that the design of these calls for ability and extensive training and yet he will believe it possible for his own highly complex business to be handled efficiently in some remarkably simple manner, which he leaves the members of his organization, who have had no special training in the formulation of efficient routine methods, to find out.

Why Complex Business Demands Complex Systems

There is no way of avoiding considerable complexity in the design of systems to efficiently handle a complex business, but as was previously stated the complexity should stop right there for a system which is unduly difficult to operate is to that extent

defective in design. Some of the most complex pieces of machinery in common use are simple enough to operate; if they were not they would not be in common use. What proportion of telephone users have any real conception of the means by which the sound of their voices is carried over the telephone wires, yet ignorance in this respect does not in any way detract from the value of the service they receive from their telephone. Take, as an example, the magnificent twin-six automobile which we often see skillfully driven by women. The design of that machine represents the crystallized experience of a multitude of skilled engineers, electricians, and others. But do many women know about all of its manifold parts and complications? The reader knows perfectly well that the chances are that they do not, in fact, it is quite possible that they do not know the difference between the differential and the carburetor, and if they have given any thought to the matter at all, which is to be doubted, it is more than possible that reasoning by analogy and bearing in mind the heating system in their own homes they believe that the function of the radiator is to keep the engine warm!

In the previous chapters of this volume the diagrams illustrated were confined to the work of the cost department and to the compilation of cost and efficiency data. As was stated, however, one of the essential requirements of a cost system is that it should be coördinated with the work of the production and allied departments, so that duplication of work and overlapping of authority can be avoided. The coördination of systems of cost predetermination with the factory planning systems along the lines of those described in this volume is a logical and inevitable development of the predetermined cost idea and until such coördination is realized both the cost and planning systems must necessarily fall far short of the ideal.

The Diagrams of a Coördinated System

The diagram illustrating the coördinated cost, planning and production system to be described, is divided into eight related sections. These are as follows:

1–2 Method of compilation of standard cost and planning data (Figures 9 and 10)

3 Routine in connection with machine-group planning and control (Figure 11)

4 Routine in connection with material and production control (Figure 12)
5–6 Routine in connection with planning and dispatching control (Figures 13 and 14)
7–8 Routine in connection with cost and efficiency control (Figures 15 and 16)

In the plan illustrated full advantage is taken of the increased facility in planning and recording production, afforded by the use of graphic charts, two such charts being illustrated, the machine group planning and control board (Form 3A, Figure 11) and the graphic material and production control record (Form 4A, Figure 12).

The Development of the Graphic Idea

The modern development of the picture or graphic idea in connection with records of production, etc., has been in response to the demand for some plan which would furnish immediate information relative to the progress of work in the shops, expressed in such form as instantly to draw attention to the salient features of the situation. Under the older method of production accounting, this information would be buried in books of record involving a regular mining operation to bring to the surface.

For instance, in the case of a concern manufacturing a standard line of machinery involving the manufacture of thousands of parts many of which would be common to several machines, in the older method of production accounting a record would be maintained in book form of the manufacture and use of each part, a sheet in the book being provided for each part. To determine what the manufacturing situation at any time was as regards these parts it would be necessary to abstract the balances of the part record and apply these against the requirements of the various machines to be manufactured, taking into account the fact that this assembly might require four of a given part, while another would only use two of that part. The compilation of this information being a laborious undertaking it would only be done at considerable intervals and even then would not be up-to-date, so that when information was required relative to the manufacturing position the usual procedure would be to visit the bins or shelves.

In factories where such methods are employed it will be found

that time and time again the completion of machines, urgently required by customers, will be delayed owing to the absence of one or two minor parts and very often it will be discovered at a late date that owing to some oversight material necessary for the manufacture of some essential part has not even been ordered. In many factories there is an appalling waste of the time of superintendents and other high-priced men owing to defective routine such as has been described, a large proportion of many a superintendent's time being employed in what is known as "stock chasing."

A considerable forward step was made when the information incorporated on the parts records was plotted on graphic charts which showed at all times what the manufacturing situation was as regards the parts required for the completion of the various machines included in the manufacturing schedule. Compared with the older method where information was buried in the stock records the new plan under which the superintendent and his assistants had before them a picture showing at all times which parts were available and which were behind schedule presented such marked advantages that it has not been realized in the majority of cases that even the new method falls short of the ideal.

Material and Production Records

The shortcomings of a plan under which the progress of work is plotted on a chart by means of lines which are extended, or pins which are moved, from day to day, as manufacturing progresses, are as follows. The record showing as it does only the position at date cannot be used to show comparisons of the position at different dates. In some cases this disadvantage has been realized and overcome to a limited extent by taking photographs of the production boards at intervals. This, however, must be admitted to be a make-shift method. The plan involves an undesirable duplication of work, the information first requiring to be recorded on the written records and from these plotted on the graphic chart.

It was a realization of the shortcomings of the method described which led the author to develop a plan under which the written record is combined with the graphic chart and this method is illustrated in the graphic material and production control record shown in Form 4A, Figure 12. In this illustration the manufacturing position as regards the manufacture of

parts for, and the assembling of, a planter frame is shown as at two dates; the upper illustration showing the position at January 17 before assembling was commenced, and the lower the position a month later after assembling was well under way.

The heavy perpendicular red line reflects the material situation. When all of the raw material necessary for the manufacture of a part is available this red line is filled in; if only part of the material required is available a horizontal red line is drawn to the point on the scale corresponding to the number of the parts which can be made from the available material. For instance, on the upper section of the illustration it will be seen that at January 17 all of the material necessary for the manufacture of the first two parts listed (Nos. 313 and 649) was available, but that as regards the third part listed (No. 368) material was only available to manufacture 780 parts, and as two of these parts are required for each planter frame the horizontal red line is drawn to the 390 point on the assembly scale shown at the bottom of the chart.

Production of parts is shown by daily postings of cumulative totals, postings for any day being made in the column coming under that day according to the part production date scale shown at the top of the chart. For instance on January 17 (the date at which the position is shown in the upper illustration) 510 pieces of part No. 649 were completed, and accordingly this quantity is posted on the line of this part in the column of January 17 on the part-production date scale. The position as regards part manufacture is shown graphically by means of red pins placed at the point of the assembly schedule scale represented by the number of parts manufactured. For instance, in the case of part No. 649, just referred to, only one of these parts being required in a planter frame, the production of 510 pieces of this part fully meets the requirements of the schedule for 510 assemblies, and accordingly the red pin is placed to the extreme right of the line provided for this part, indicating that production thereon is complete.

A glance at this chart will give all salient information relative to progress made in connection with the manufacture of the planter frame taken as an illustration. It will be seen that work held up on part No. 109 owing to lack of material, that work will shortly be held up on part No. 368 for the same reason, and the chart also clearly indicates which parts have been produced to meet total requirements, and which parts are lagging in production.

In the lower illustration, which represents the position of work on the planter frame a month later, it will be noted that the progress of assembling is indicated by a black perpendicular line, and that all assembling is held up owing to the material for part No. 109 still being unavailable. A valuable feature of this method of showing the progress of assembling by means of a perpendicular line in a business where one part is common to several assemblies, is that the chart shows instantly which parts can be borrowed for another assembly without necessitating tearing down assemblies already completed. For instance, in the case illustrated it will be seen that 510 pieces have been made of part No. 313, but as 200 assemblies have been completed, as indicated by the perpendicular black line, only 310 pieces of this part are available without necessitating tearing down assemblies.

Chapter VI

THE IMPORTANCE OF DELIBERATION IN INTRODUCING CHANGES

THE old saying, "More haste, less speed," applies with particular force to the efforts which are so often made to introduce new methods of cost accounting, planning, and production, without proper deliberation at the outset. Though the "do it now" slogan is excellent considered as a warning to the habitual procrastinator, it is not a policy to be followed blindly when dealing with so necessarily a complex proposition as a system of routine methods suitable for the modern business.

Manufacturers do not always realize that the desire which they express for an immediate showing is often the direct cause of hasty and unwise action on the part of those to whom they intrust the work of introducing improved methods in their factories and offices. There is no royal road to learning and neither is there any easy path to business efficiency.

The simplest and most direct manner in which to obtain the desired results from a system of cost accounting, planning and production is not going to be stumbled upon by accident; it can only be found by careful and deliberate thought directed toward the end in view.

There is a serious feature in connection with losses due to improperly designed routine methods which is often overlooked; a loss such as a bad debt can be written off and in course of time forgotten, but there is no finality to the loss due to inefficient methods, for these involve a continued drain on a business and a mortgage upon its future. In a large business it is nothing unusual to find that owing to careless design of the system employed, it is necessary to retain on the payroll six more clerks than would be required had sufficient thought been given when formulating the plan to the question of economy in operation. Possibly a thousand dollars was saved at the outset through employing semicompetent assistance in designing the system and in hurrying its installation, but if ever there was a case of saving at the spigot and losing at the bunghole

it is here, for the cost of six clerks, say $6000 a year, represents 6 per cent interest on an investment of $100,000.

Carefully Planned Changes Build Morale

There is a sound psychological truth underlying the proverb "Nothing succeeds like success," and there is nothing so damaging to the morale of an organization as the consciousness of failure. The haphazard, hit-or-miss methods employed so often in introducing changes in routine methods, involving as they do a continuous process of trial and error and the everlasting changing of forms, are detrimental in the extreme to the spirit of shop and office employees, while, on the other hand, changes introduced after proper deliberation and with satisfactory results develop a spirit of optimism toward later attempts at bettering conditions which aids materially in the achievement of success.

Far too often the procedure followed in the effort toward introducing improved methods in a business is the reverse of what is correct; instead of starting at the foundations and laying out a comprehensive general plan and then developing the details, minor questions are considered first and the general plan left to take care of itself. The executive, however, demands immediate results and as a consequence of his misguided "do it now" policy, without proper preparation, with little if any data and with no definite general plan, a start is made.

The natural result of introducing details before the general plan is formulated is disappointment and wasted effort. Such a method of approaching the problem is like the roads which the Russian soldiers followed in the Masurian swamps, they looked all right at the start but they led to disaster.

General Manufacturing Position Must Be Shown

The average planning system, as is to be expected considering the methods followed in introducing it, is strongest at the detail end. It shows clearly the immediate requirements against machines, but is exceedingly defective when it comes to showing the general manufacturing position, that is the total work ahead of machines represented by all orders on hand, in comparison with the capacity of the machines. The faculty of bringing all information relative to manufacturing requirements and resources to a focus and of being able to present a bird's-eye

view of the general situation so that the sales and manufacturing executives can direct their policies intelligently on the basis of a complete knowledge of the situation is the supreme test of the comprehensiveness of the general plan. When this is coupled with complete detailed control all along the line and coördinated with adequate cost and efficiency records, then and only then have we a plan that can be considered suitable to meet the needs of the modern manufacturer.

The machine group planning and control board illustrated in Form 3A, Figure 11 provides the manufacturer with the bird's-eye view of the manufacturing situation referred to in the preceding paragraph. This board shows graphically the extent to which the capacity of all machines in the shop is appropriated to manufacturing schedules and also, approximately, when completion of the various classes of product required by the sales department on various dates may be expected.

In this machine group planning and control board capacity of machines is appropriated to manufacturing schedules by the use of scaled cards. As shown in Form 3B, Figure 11, an allowance of 10 per cent of capacity is made to cover breakdowns, work on special repair-part orders, etc., so that the scale for one machine for nine days covers ten days according to the date scale. Different scales are provided for machine groups when there is more than one machine performing identical work, the scale for a three-machine group for a given number of machine hours being one-third of that of the one-machine scale.

When a manufacturing schedule is made for any class of product for completion during a given month, the total standard hours for each machine group necessary for the completion of this schedule is figured (Form 3D, Figure 11) and cards of the requisite length are cut for each machine group, these cards being placed in the slots for the proper machine groups on the machine group planning and control board. Different colored cards are used for the various months in which completion of the different schedules is called for, these colors corresponding with those used for the same months on the date scale at the top of the board. For example, the standard days of machine time on the power shears required for the planter schedule to be completed in February was 125 (refer again to Figure 11). There were three machines in this group, so that a card of the color chosen to indicate the month of February was cut on the three-machine group scale (Form 3E, Figure 11). This card placed in the machine group planning board in the power

shear slot extends slightly beyond the February date scale so that it will be obvious that, unless the efficiency of these machines proves to be better than standard or overtime is worked, it will be impossible to complete the planter schedule in the time set.

The board is kept up to date by obtaining through an automatic sorting and tabulation of the operation cards (Forms 3H and 3G, Figure 11) the standard hours of work produced by each machine group for each class of product scheduled for completion in different months, the cards in the machine group planning and control board being cut down accordingly. Each day the date line on the board is moved forward as illustrated, the cards in each slot being brought into alignment therewith.

In order to indicate at a glance what proportion of the work of a machine group on a schedule has been completed, a diagonal line is drawn across the card so that the position of the commencement of this line at the point where the card was cut down will show the proportion of the card cut off. This is illustrated in Figure 10A.

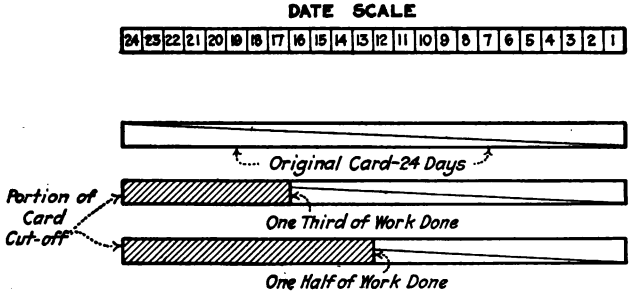


FIG. 10A.—Diagram illustrating use of diagonal line to indicate proportion of work performed on manufacturing schedule.

The advantages of this board to the sales and manufacturing executives are obvious. It indicates which classes of machines have not sufficient work ahead of them and those where capacity is insufficient. It shows what effect on the date of completion of the schedule for one class of product will result from scheduling another class of product concurrent with or ahead of those already scheduled. It does not pretend to control detailed operations but it represents the key to the whole manufacturing situation.

In the previous chapter the operation of the graphic material production and control record (Form 4A, Figure 12) was discussed at considerable length. This record shows at any time

the progress made as compared with the schedule of the manufacture of parts and the completion of assemblies, and holds an intermediate position in the series of graphic mediums employed in the control of production under the system illustrated in the series of eight diagrams. Detailed control of operations to individual machines is obtained through the medium of the dispatch board (Form 6A, Figure 14), the operation of which is fully explained in the text accompanying the diagram.

The Variety of Information Obtainable

One very important advantage resulting from the careful planning of a coördinated cost, production and planning system, is the possibility of so arranging original records that a multiplicity of results can be obtained therefrom merely by resorting and retabulating the cards on which the original data are recorded. Examples of the variety of information obtainable in this manner and without rewriting are as follows:

Material Operation Card

1 To obtain material requirements for the entire manufacturing schedule (see first automatic tabulation of material operation cards, Figure 12)

2 For following up material deliveries and for applying material received to individual schedules (see second automatic tabulation of material operation cards, Figure 12)

3 For recording material issues (see third automatic tabulation of material operation cards, Figure 12)

4 To obtain material distribution by material and product classes and variations in costs due to price fluctuations (see fourth automatic tabulation of material operation cards, Figure 16)

5 To obtain variations in material cost due to fluctuations in price as compared with standard (see fifth automatic tabulation of material operation cards, Figure 16)

In addition to the above uses the material operation card is also employed as a material move ticket as explained in the text accompanying Figure 13.

Operation Card

1 To obtain standard hours produced by machine groups by production schedules for the purpose of the machine group planning and control board (Figure 11)

2 By tabulating cards for last operation only, to obtain production of parts for purpose of graphic material and production control record (Figure 11)

3 For obtaining distribution of labor, both actual and standard, by classes of product and for distribution of machine burden by classes of product (Figure 15)

4 To obtain actual and standard labor costs by departments for the purpose of the summarized manufacturing statement (Figure 15)

5 To obtain ratios of actual to standard labor cost by departments and product classes for the purpose of adjusting standard costs to current cost basis (Figure 16)

In addition the operation card is used for the making up of the payroll and the figuring of the efficiency of individual operators, and classes of operators.

Chapter VII

THE PRINCIPLES OF SCIENTIFIC MANAGEMENT

THE general trend of progress would seem to have made certain discoveries more or less inevitable. The discovery of the heavier-than-air flying machine was a natural concomitant to the development of the internal combustion engine and, doubtless, if the Wright Brothers had not invented the aeroplane when they did some other inventor would have done so before long. In fact, the modern aeroplane may be said to have been merely a combination of two other inventions, for Langley's model actually flew when its original motor was replaced by a modern aeroplane engine. Likewise the principle of selection was "in the air" when Darwin discovered it as is evidenced by the same idea occurring simultaneously and independently to Alfred Russel Wallace.

In the same manner it was inevitable that the idea of scientific management would be developed, for even if Frederick Taylor had not undertaken his investigation the demands of the industrial world for some more scientific means of meeting manufacturing problems than were previously employed would have rendered the introduction of the scientific management idea a foregone conclusion.

Coming as it did as a direct response to the needs of the manufacturing world for some improvement over the old-time haphazard methods of management, the industrial world was ripe for the acceptance of the idea of scientific management and this made such headway with the progressive manufacturing element that, though it is only about 15 years since Taylor presented his famous paper on "Shop Management" to The American Society of Mechanical Engineers, there is hardly a manufacturing concern of any magnitude that does not apply to some extent the principles which he enunciated.

Scientific Management a Natural Trend

The idea of predetermined results and standardized methods was in line with the natural trend of the engineer's mind and

his methods of working as applied to machine design and construction, for no engineer would think for one moment of building a machine without first carefully laying plans on paper, and accordingly Taylor's idea of employing constructive imagination in the field of factory production was welcomed by the engineering mind as being entirely logical and proper.

It takes time, however, for the full significance of an important new idea or discovery to be realized and what would seem obvious and inevitable applications of such an idea when considered in the retrospect are often very slow in being adopted. The Roentgen rays were discovered in 1895, but only in recent years has the dental profession taken advantage to any extent of the tremendous assistance in oral diagnosis which is afforded by the use of radiography, the introduction of which in this profession is revolutionizing the methods employed.

A classical instance of the failure of the human mind to grasp the significance of any new idea is associated with the discovery of ether in 1530, for though it was used ten years later by Paracelsus to make animals unconscious under experiments, three hundred years of human suffering elapsed before the importance of the experiments of Paracelsus was appreciated and ether used for the alleviation of the pain of humanity.

In a similar manner the full significance of the scientific management idea has not been realized, the application of the principles of this science being still in the main confined to the shops. Even Frederick Taylor himself did not fully realize the far-reaching possibilities of the principles he developed—essentially a shop man, his horizon was in the main limited to shop problems, and later exponents of these principles have largely followed in his footsteps.

Scientific Management More Than Shop Management

To most writers on the subject, scientific management means scientific shop management and nothing more. Mr. C. Bertrand Thompson in the voluminous collection of articles on scientific management edited by him defines this subject as follows:

> The aim of scientific management is to correlate and systematize all of the best development in factory administration and to push development further in accordance with the principles discovered.

Another writer states:

> The aim of scientific management is to manage production in such a way that higher wages bring a decreased cost.

Shorn of all non-essentials, the underlying idea of scientific management is the predetermination of results and the standardization of methods and conditions. Instead of working to more or less nebulous ends, under scientific management methods definite ideals are established and all efforts concentrated towards the attainment of these ideals by the adoption of standardized methods. This principle is applicable not only to the shops but to all phases of human activity.

Scientific management is more than a system of shop management; it is akin to a state of mind, a mental attitude. Considered in its essential features scientific management represents the use of the trained imagination in industrial life—a looking forward rather than a looking backward—the doing of things mentally before the attempt is made to perform them on the physical plane. The office manager who desires to rearrange his office and who cuts pieces of paper to the scale of the furniture and shifts these around until he has found an arrangement which suits him is practicing scientific management, whereas he who has all the furniture moved around bodily, only to find that the original arrangement was best, is not. The traditional plumber arriving on his job without his tools represents the antithesis of the scientific management idea.

The full significance of scientific management has, however, yet to be realized by the business world. It is true that every executive more or less unconsciously applies the principles of scientific management in his business and the success or failure of a business in large measure depends upon the ability of the executive to foresee the results which will follow the taking of any given course of action, but outside of the shops the application of these principles has been more or less desultory.

The Elements of Successful Operation

The successful operation of a war, a ship or a business is dependent in large measure on:

1 The ability to plan; to determine and adopt the best methods to obtain the best results from given conditions, and to make accurate forecasts of the consequences following the adoption of a certain course of action

2 The provision of means for obtaining immediate in-

formation as to variations between the actual results and the forecast

3 The power of making quick adjustments in plans to conform to variations so disclosed

The above principles are followed to some extent by all successful executives. The progressive treasurer is at all times looking into the future; he has before him a statement showing his estimated resources and requirements for several months ahead on the basis of which he negotiates his borrowings, follows up his collections and handles his funds. Each day, parallel to the estimates is recorded actual information relative to commitments, sales collections and disbursements so that by watching variations between his estimates and the actual results he can adjust his financial policies to obtain the best results from conditions. Even the government makes use of forecasts in its crop reports, as Roger W. Babson states:

> Of all statistics published by the Government the most important to the merchant are crop reports. Most of the Government figures refer to what has happened in the past, and many of these figures are published a year or more after the events have happened. In the case of the crops, however, the Government actually forecasts. Therefore, all crop statistics are especially valuable to manufacturers and merchants.

The modern, progressive sales manager, analyzes his market carefully to determine which class of customer constitutes the potential market for his product, to ascertain where that class is located and to find out what channels of distribution are most readily available for reaching them. For instance, the sales manager of a concern manufacturing and marketing a machine milker would collect very complete information relative to dairy farmers in the various districts, giving particular attention to those farmers who had a sufficiently large number of cows to render the introduction of milking machines a good investment, and based upon this analysis would direct the activities of his selling organization so that the returns therefrom will bear the greatest ratio to the effort expended.

On the basis of the analysis would be set the salesmen's standards or quotas. Under this method, the salesman, instead of having a vague and general idea of doing his best, is provided with a definite standard of accomplishment based upon carefully worked out possibilities.

In the early days, before salesmanship had developed, each salesman was left to work out his own salvation—to develop

his own methods of approach and his own arguments, but the scientific sales manager standardizes these things in a prepared argument, which contains every selling point that has been developed in years of experience and demonstration.

The Experimental Method

In a selling campaign under which it is planned to send out a large number of letters, say 250,000, under scientific management methods a number of tests would be made of different letters, perhaps 1000 at a time, these being sent to representative groups, the test letter from which the largest number of replies were received being adopted as a standard for the big mailing. In this case (provided the list used was sufficiently representative and the number of letters mailed sufficiently large) the law of averages will apply and if 15 replies are received from the test mailing of 1000 letters it may reasonably be expected that the result of the mailing of 250,000 letters will be in the neighborhood of 3750. Under the hit-or-miss method the letter sent out in the big mail might not pull at all, a fact which could have been ascertained at small expense by using the test method.

The modern purchasing agent more or less unconsciously applies the principles of scientific management. Instead of buying coal by the ton, he purchases fuel according to heat units. Instead of buying any kind of belting, or the cheapest, he purchases this according to specifications drawn up after careful tests. Steel is purchased by analysis. The modern purchasing agent is as well posted as to the sources of supply and the cost of production of his major items of purchase as the modern sales manager is as to the field of distribution and the cost of marketing his own product.

The efforts which are made by the treasurer, the sales manager and the purchasing agent to predetermine results are an indication of the tendency of business to look ahead, of the change of viewpoint of the entrepreneur from retrospection to prospection. The benefits which should be derived from these efforts are greatly curtailed, however, owing to the absence of centralization and coördination.

Strictly speaking, there is no such thing as an interdepartmental problem; factors influencing the plans of one department of a business must also directly or indirectly affect the plans of the other departments. The treasurer's forecasts of collec-

tions are based upon the sales manager's estimates of sales and anything which affects the latter's plans must also influence those made by the former. The estimates of sales made by the sales manager are dependent upon the deliveries which can be made by the factory manager and accordingly any circumstance which affects the productive capacity in like manner influences the plans of the sales manager and of the treasurer.

There is one department which should be in a position to coördinate the efforts of all other departments, this is the accounting—the one department which in the average business has not kept abreast of the general advance. When all other departments are looking into the future the outlook of the accounting department is still confined to what has happened and its work to the compilation of records of past events.

The Two Problems of Operation

The operation of a business is similar to the navigation of a ship, the two fundamental problems in navigation being:

1 The determination of the ship's position at a given moment

2 The decision of the most advantageous course to be steered in order to reach a given point

The first of these problems is that of the accountant, the second that of the executive. It is along these lines that the true function and destiny of the accountant of the future lies, it is his duty to chart the course which is laid down by the executives and to show at all times what the actual position is as compared therewith.

In the industrial world it is impossible to foresee with certainty what the morrow will bring forth. As the poet says, "The best-laid schemes o' mice an' men gang aft a-gley," and the problem of business is mainly one of adjustment to changing conditions, of maintaining an equilibrium of opposing forces. The farther, however, we can see ahead and the quicker we can trim our sails before the approaching storm, the more certain we are of reaching the hoped for haven. No general can foresee with certainty what moves his opponent will make, but the more flexible his forces, the quicker he can take advantage of a false move of the enemy, the greater the probability of victory.

The fact that it may be necessary to be continually revising plans is not an argument in favor of not making plans, but rather emphasizes the importance of making them. Every head of a business should have before him at all times the chart of the course which he is planning to take, and of his position at the moment in relation thereto.

The predetermination of results or the setting of objectives in the operation of a business calls for:

1 Estimated volume of sales
2 Estimated selling prices
3 Estimates of costs and expenses
4 Estimated profits

Variations in any of the first three obviously affect the last.

An Illustration of the Principle of Predetermination

The actual methods to be followed as regards the predetermination of results depend in large measure on the character of the business. The principles to be employed, however, can be demonstrated by taking a simple illustration and following it through; in this, as in previous illustrations, it being understood that the example taken is purely hypothetical and the results shown far different from what might occur in actual practice.

The conditions existing in the case taken as an example are assumed to be as follows:

The business is that of manufacturing autotrucks, one model only being produced. It is assumed that this is a new venture and conditions somewhat uncertain. It is estimated that the sales for the year will be at the rate of 250 trucks a month. It is also estimated that the sales price which will be realized will be $1000, the cost (including all expenses) $800 and the net profit thus $200 a truck. The estimated cost of a truck is made up as follows:

Material	$300.00
Labor	100.00
Factory burden	250.00
Administrative expense	50.00
Selling expense	100.00
Total	$800.00

A summarized forecast of profits for the year is made up as follows:

Estimated sales, 3000 trucks at $1000 each	$3,000,000
Estimated cost, 3000 trucks at $800 each..	2,400,000
Estimated profit, $200 per truck.....	600,000

This estimate expressed in chart form is shown in Figure 17 where separate lines are shown for estimates of sales, cost of sales and profits. Actual results would also be plotted on this

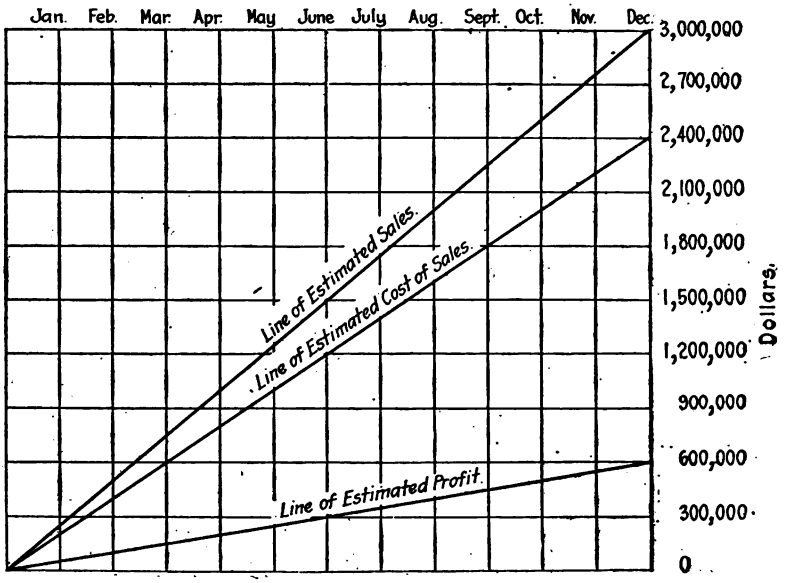


FIG. 17.—Method of charting forecast of profits.

chart so that a comparison of these with those of the estimates would show the extent to which the business ship has deviated from the course laid down.

Now under the form of accounting here illustrated all results require to be shown in relation to the estimates. It is assumed that the manufacturing costs have been predetermined according to the methods previously explained in these articles and that the administrative and selling costs, based upon sales of 250 trucks a month, have also been carefully predetermined. All efforts are concentrated toward the realization of $50,000 a month profit—responsibilities are apportioned between the selling and manufacturing departments, the former to dispose of

250 trucks a month at a price of $1000 and at a selling expense of $100 a truck and the latter to deliver these trucks at a factory cost of $650.

Detailed statements showing the variations from estimates for three months are given in Tables 19, 20, and 21, the informa-

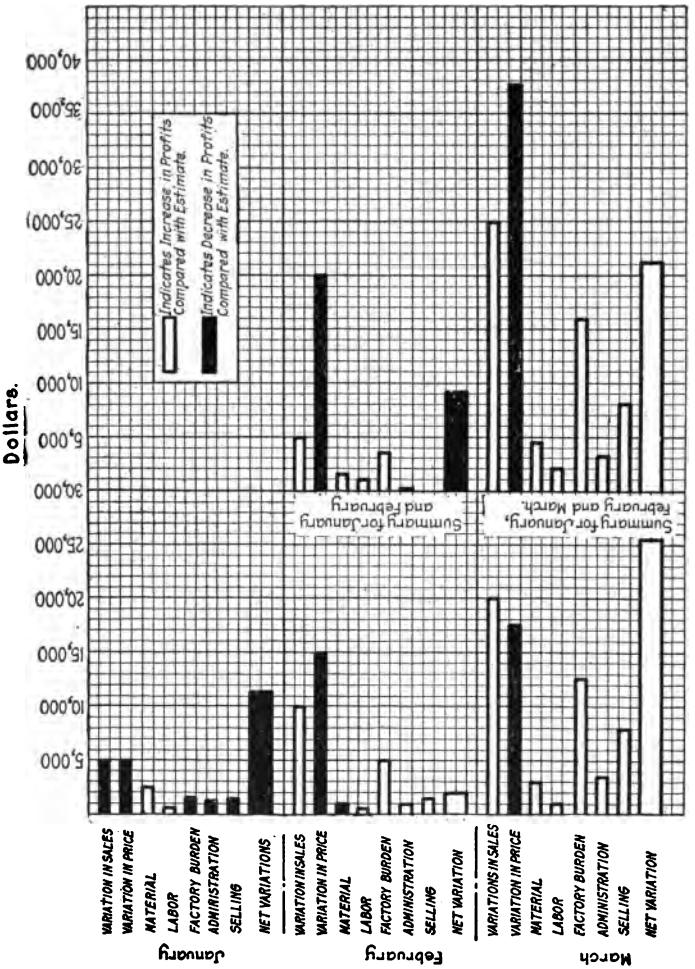


FIG. 18.—Variation chart showing deviations from estimates or forecast of profits.

tion appearing on these statements being charted on the form illustrated in Figure 18. All figures on these statements are expressed in relation to their effect upon the estimated profits, the results shown on the statements being summarized as shown in Table 22.

TABLE 22. INCREASES OR DECREASES IN COMPARISON WITH ESTIMATED PROFITS

	January	February	March	Total
Due to variations in volume of sales.	*$5,000	$10,000	$20,000	$25,000
Due to variations in price.....	*5,000	*15,000	*17,500	*37,500
Due to variations in cost of sales:				
Cost of material.....	2,500	*1,000	3,000	4,500
Labor.....	500	500	1,000	2,000
Factory burden.....	*1,500	5,000	12,500	16,000
Administration expense.....	*1,250	1,000	3,500	3,000
Selling expense.....	*1,500	1,500	8,000	8,250
Total.....	*$11,250	$2,000	$30,500	$21,250

Asterisk (*) denotes decrease.

A consideration of the first month's statement (Table 19) will show that the market conditions were not properly predetermined. The price of the truck was too high to meet competition and in spite of the fact that 50 trucks were sold at a reduced price of $900 ($100 less than the standard) the volume of sales was 25 trucks less than the estimate. This condition resulted in a loss of the $200 profit on the 25 trucks not sold, making a total of $5000 and a loss of $100 apiece on the 50 trucks sold under the estimated selling price totalling $5000 more and making a total loss, as compared with estimate, of $10,000. The manufacturing department managed to keep their costs below standard but owing to the decreased volume of sales the selling and administrative expense per truck was above standard.

Obviously a complete change in selling policy was necessary if the estimated profits were to be realized and it was decided to reduce the price of the trucks to $950, the effect of this policy being shown in the statements for February and March. In February, as a result of the change in selling price, the number of trucks sold was 50 in excess of the estimate, which would have resulted in an increased profit over standard of $10,000 had the price been maintained. Owing, however, to the reduced price there was a corresponding loss of $15,000 making a net loss, as compared with estimate, of $5000, but this was more than offset by the decrease in factory burden, selling, and administrative costs per truck, owing to the increased volume of business over standard.

In the month of March (Table 21) the number of trucks sold was 100 in excess of standard which would have resulted in an increased profit, as compared with the estimate, of $20,000 had the price of $1000 per truck been maintained. The reduction in price of $50 resulted in a decrease in profits of $17,500, so that at this point the profit due to increased sales more than offset the loss due to decreased selling price, with the result that the large savings in factory burden, sales and administrative expense due to the increased production were all velvet, the net profits for the month being $80,500 or $30,500 in excess of the estimate.

Obviously, under these conditions the original estimates require revision—instead of figuring on selling only 250 trucks a month the sales manager decides that if he still further reduces the price to $900 he ought to sell 400 and the factory manager advising that he can produce this number of trucks, the new plans are figured on this basis. It is figured that the March figures for factory burden, administrative and selling expense can be maintained and the revised forecast for the cost of a truck during the next 12 months is made up as follows:

Material	$300.00
Labor	100.00
Factory burden	187.50
Administrative	35.00
Selling expense	67.50
	$690.00

These figures then give a revised forecast of profits as follows:

Revised estimated sales, 4800 trucks at $900 each	$4,320,000
Revised estimated cost, 4800 trucks at $690 each	3,312,000
Revised estimated profits, $210 per truck	$1,008,000

The new forecast of revised figures is shown in chart form in Figure 19 and until conditions change sufficiently to render it desirable to make a further revised forecast the accountant will show monthly the position of the business as regards costs

and profits in comparison with the revised course as laid down on this chart.

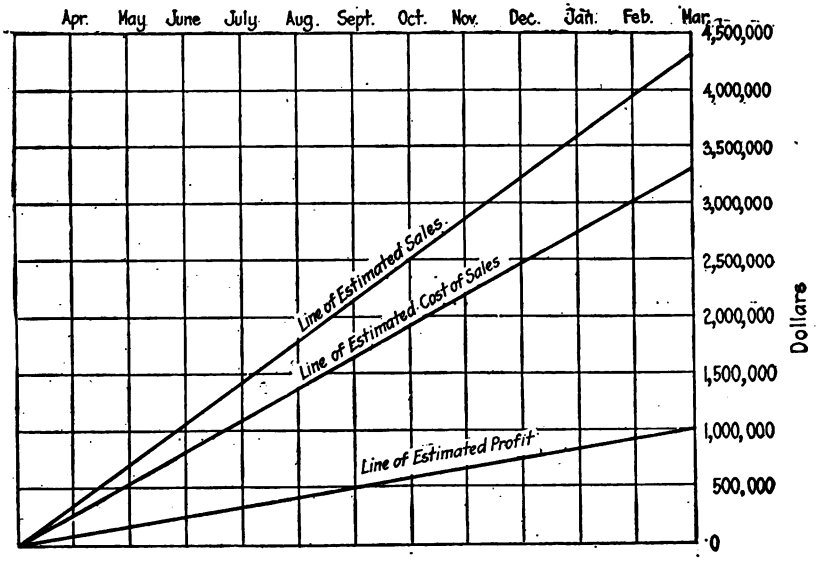


FIG. 19.—Chart showing revision of forecast of profits.

TABLE 19. STATEMENT SHOWING VARIATIONS FROM ESTIMATED PROFITS DURING THE MONTH OF JANUARY

			Increase or Decrease in Profits as Compared with Estimate	
			Increase	Decrease
Estimated sales of trucks for month	250			
Actual sales	225			
Decrease	25			
Loss of standard profit on trucks not sold: 25 trucks at $200.00			.....	$5,000.00
Loss of standard profit due to sales made at prices less than standard: 50 trucks sold at $900.00 (loss of $100.00 per truck)			.....	5,000.00
Cost of sales in month	Actual	Standard		
Material	$65,000.00	$67,500.00	$2,500.00	.....
Labor	22,000.00	22,500.00	500.00	.....
Factory burden	57,750.00	56,250.00	.....	1,500.00
Administration	12,500.00	11,250.00	.....	1,250.00
Selling	24,000.00	22,500.00	.....	1,500.00
Total	$181,250.00	$180,000.00		
Net decrease in profits as compared with estimate			11,250.00	.....
			$14,250.00	$14,250.00

Summary Statement of Estimated and Actual Profits

	Estimate	Actual
Net sales	$250,000.00	$220,000.00
Cost of sales	200,000.00	181,250.00
Profit	$50,000.00	$38,750.00
Net decrease as above	.....	11,250.00
	$50,000.00	$50,000.00

TABLE 20. STATEMENT SHOWING VARIATIONS FROM ESTIMATED PROFITS DURING THE MONTH OF FEBRUARY

			Increase or Decrease in Profits as Compared with Estimate	
			Increase	Decrease
Estimated sales of trucks for month		250		
Actual sales		300		
Increase		50		
Increased standard profit on trucks sold in excess of estimate:				
50 trucks at $200.00			$10,000.00	.....
Loss of standard profit due to sales made at prices less than standard:				
300 trucks sold at $950.00 (loss of $50.00 per truck)			.....	$15,000.00
Cost of sales in month	Actual	Standard		
Material	$91,000.00	$90,000.00	.....	1,000.00
Labor	29,500.00	30,000.00	$500.00	.....
Factory burden	70,000.00	75,000.00	5,000.00	.....
Administration	14,000.00	15,000.00	1,000.00	.....
Selling	28,500.00	30,000.00	1,500.00	.....
Total	$233,000.00	$240,000.00		
Net increase in profits as compared with estimate			.....	2,000.00
			$18,000.00	$18,000.00

Summary Statement of Estimated and Actual Profits

	Estimate	Actual
Net sales	$250,000.00	$285,000.00
Cost of sales	200,000.00	233,000.00
Profit	$50,000.00	$52,000.00
Net increase as above	2,000.00	.....
	$52,000.00	$52,000.00

TABLE 21. STATEMENT SHOWING VARIATIONS FROM ESTIMATED PROFITS DURING THE MONTH OF MARCH

			Increase or Decrease in Profits as Compared with Estimate	
			Increase	Decrease
Estimated sales of trucks for month	250			
Actual sales	350			
Increase	100			
Increased standard profit on trucks sold in excess of estimate:				
100 trucks at $200.00			$20,000.00	.....
Loss of standard profit due to sales made at prices less than standard:				
350 trucks sold at $950.00 (loss of $50.00 a truck)			.....	$17,500.00
Cost of sales in month:	Actual	Standard		
Material	$102,000.00	$105,000.00	3,000.00	.....
Labor	34,000.00	35,000.00	1,000.00	.....
Factory burden	75,000.00	87,500.00	12,500.00	.....
Administration	14,000.00	17,500.00	3,500.00	.....
Selling	27,000.00	35,000.00	8,000.00	.....
Total	$252,000.00	$280,000.00		
Net increase in profits			.....	30,500.00
			$48,000.00	$48,000.00

Summary Statement of Estimated and Actual Profits

	Estimate	Actual
Net sales	$250,000.00	$332,500.00
Cost of sales	200,000.00	252,000.00
Profit	$50,000.00	$80,500.00
Net increase as above	30,500.00	.....
	$80,500.00	$80,500.00

Chapter VIII

COST ACCOUNTING AND THE SALES MANAGER

AS defective threads running through a piece of cloth render the whole imperfect, so the whole fabric of a business is weakened by inefficient methods of cost accounting. Success in business is the result of exercising sound judgment based upon accurate knowledge of conditions, and if the executive is not furnished with reliable and adequate information relative to his cost of manufacture and of distribution he is in the predicament of the master of a ship without the means of determining his position. When consideration is given to the fact that the majority of business concerns are operating without adequate information relative to their conditions and only determine their true position at the time of the annual inventory, it is not surprising that so many firms are wrecked but rather that so many inefficiently equipped business vessels do arrive at the fair haven of satisfactory profits.

In the shortcomings of its competitors lies the salvation of the average business; with one competitor a strong selling force is handicapped by an inferior product, with another, factory costs are excessive, with a third costs of distribution are extraordinarily high, and so on, with the result that a business may meet with a fair share of success despite numerous defects in its methods so long as the business as a whole is not operated very much less efficiently than that of its competitors.

Generally speaking, the greatest handicap to efficient business operation is that of incomplete, inadequate and inaccurate information relative to costs and profits, the average sales manager basing his selling prices very often on the quotations of competitors equally uninformed as to the cost of manufacturing and doing business, so that the direction of sales activities is largely a case of the blind leading the blind.

So long as all of the competitors of a business are equally in the dark as regards costs, the handicap resulting from this condition is more or less uniform, but the situation is entirely changed when some more progressive competitor energetically

and systematically undertakes the introduction of reliable cost methods and instead of working partly by intuition, partly by guesswork and partly on incomplete and inaccurate information, handles his business on the basis of accurate and complete cost data. Under these conditions, all other things being equal, he cannot fail to outstrip his less efficient competitors.

Business is largely conducted according to the law of averages; owing to the general absence of adequate data in many industries the current prices for various products carry widely fluctuating rates of profit, the average profits representing the mean between excessive profits for some articles or lines and inadequate profits, and in some cases losses, in other articles or lines. The author knows of several instances where advantage has been taken of this condition and owing to close coöperation between the sales manager and an able comptroller the selling policy has been successfully adopted of as far as possible taking the business on which the large profits accrue and leaving to competitors that business which at current rates must either be handled at a small margin of profit or at a loss.

Careless Figuring Brings Loss

Printers are notorious for careless figuring of costs and the author calls to mind one case where owing to the defective cost methods employed by a printer a large proportion of his business was accepted at a loss. In this case there were two printers in competition, one of whom figured his costs carelessly and apparently relied upon the law of averages and that losses due to under-figuring some items on a quotation would be offset by overfiguring of others. The other printer had a reliable cost system and based his quotations on a reasonable percentage of profit over cost. Comparisons between the bids of these two printers would invariably show that the printer who did not figure his costs accurately quoted prices which must have been under cost and this was naturally the business he most often received, with the result that the work he was doing for his largest customer was handled at a dead loss.

In many cases the information furnished the sales manager by the cost department is worse than no information at all, for not realizing how incorrect it is the sales manager is apt to place an entirely unwarranted confidence in it to the consequent detriment of the profit and loss account. This is particularly

so in those cases where incomplete systems of cost accounting are followed, where the costs are not controlled by the general accounts, and where the usual question at the end of the year is, "Where have our profits gone?" for according to the costs with which the sales department was furnished it appeared that there was an ample margin of profit on the orders accepted. There is something rather pathetic in the wild search which is so often made at the end of the year for some large item, which supposedly must have been left out of the inventory, to account for the showing being so far below what was anticipated.

The Tendency to "Shade" Costs

In a business where costs are compiled more or less haphazardly there is always a tendency to shade costs. It not being generally feasible to verify the accuracy of the information submitted and the cost accountant having learned that a cost which may exceed the price quoted by a competitor is received with marked disfavor by the sales manager often follows the lines of least resistance and obtains a temporary popularity, at least, by submitting a cost more in accord with what the sales manager thinks it should be than in accordance with actual facts. This tendency, however, is very promptly controlled when the sales manager is furnished with monthly statements showing the actual profits realized and where any marked disparity between the profits based upon the cost department's estimates and those actually realized will call for summary investigation.

Though, as stated previously, there are many concerns that do not determine their actual position except at the time of the annual inventory, there are others who have advanced a step toward better methods and who are able to determine approximately how they stand from month to month. As an instance of this may be cited the case of a concern manufacturing a multiplicity of metal articles selling at a wide range of prices per pound, where the profits are figured monthly by comparing the average cost per pound of the goods manufactured with the average price per pound realized. Under this method which has been followed for many years there has never been any wide variance between the profits shown by totalling the twelve monthly statements and those based upon the annual stock taking, and it was claimed by the treasurer that the results obtained were sufficient to meet all reasonable requirements.

Information as to Profits Realized

It is, of course, admitted that the obtaining of information showing the monthly profits of a business in total is a marked step in advance as compared with obtaining this information solely at the annual taking of the inventory; but even this falls far short of meeting the needs of the sales manager. To enable him to properly direct the activities of the selling force it is necessary that he should be provided with the most complete information relative to costs and profits and this should include information as to the profits realized:

1 On different classes of product
2 In various territories
3 By salesmen and branch offices
4 On sales to the various classes of customers

In addition, the system should provide for furnishing any combination of this information, as for instance, profits realized in the various territories by lines of product, or profits realized on sales to the various classes of customers by lines of product, etc.

It is also desirable that the sales manager be furnished with approximate information under the above heads as regards estimated profits on unfilled orders, as it by no means follows that the profits realized on this month's shipments are indicative of what the profits will be on the orders accepted this month.

In recent years the punched card system of obtaining sales statistical data has become very generally adopted, the general principles underlying the use of punched cards and mechanical sorting and tabulating equipment having been previously explained (see Chapter IV) and therefore not requiring to be dealt with further here. In using punched cards for obtaining sales statistical data provision is generally made for the following information being punched on the cards:

1 Date of sale
2 Invoice number
3 Territory
4 Salesman's number
5 Customer's number
6 Ledger section
7 Class of customer
8 Line of goods sold
9 Amount of sale
10 Amount of freight

The number of cards requiring to be punched for each sales invoice depends upon whether a division is required to be made of the sales by lines and if this information is called for it is obviously necessary to punch as many cards for an invoice as there are different lines included thereon. If the segregation of sales data by lines is not required only one card will be needed for recording each invoice.

It is sometimes considered desirable to introduce an added refinement by extending the use of the statistical cards to furnish information relative to the shipment of individual articles, this plan rendering it necessary to punch the article number and the number shipped on the statistical card. By sorting the cards daily by article numbers and tabulating for the number of each article shipped the necessary information for posting shipments to the stock ledgers is obtained. In addition this plan enables an intensive analysis to be made, when desired, of any customer's purchases, but in general it may be stated that in most cases this is a game not worth the candle, the advantages to be gained from punching a card for each item on the invoice not being sufficiently great to compensate for the added expense involved.

The punching of the customer's number on the sales card renders it possible to obtain a complete analysis of the sales to each customer monthly by lines and a record of this character is generally found to be of considerable value to the sales manager in supervising the work of the selling force. When the customer's number is punched on sales cards it is generally found advisable to extend the use of this number to all records of the customer. Under this plan as soon as an account is opened with a new customer he is assigned the number following that last allotted which number he retains indefinitely. All correspondence with the customer is filed under this number and in addition all his orders carry this number, the customer's order number being a combination of his file number and his order sequence number, this being the consecutive number of the order received from the customer. For instance assume that the number assigned to a customer is 9114, then the first order received from him will be 9114-1, the second 9114-2 and so on. In many cases where orders are likely to be split-up, some of the goods being shipped from stock and others being made up to special order, it is desirable for the items on the order also to be numbered so that if the first order from customer number 9114 comprised four items these would be numbered respectively

9114-1-1, 9114-1-2, 9114-1-3, and 9114-1-4. In this case the whole order would be referred to as 9114-1, the item numbers only being used when it was desired to refer specifically to an item on the order.

By sorting sales statistical cards into the desired groups and then tabulating them it is possible to obtain an immense variety of sales statistical information such as the following:

1 Sales to each ledger section (for sales ledger balancing)
2 Sales by lines
3 Sales made in each territory subdivided:
  (*a*) By lines
  (*b*) By class of customer
  (*c*) By lines to each class of customer
4 Sales to individual customers either in total or by lines
5 Sales made by each salesman either in total or by lines
6 Sales made by each branch office or divided:
  (*a*) By lines
  (*b*) By classes of customer
  (*c*) By lines to each class of customer

In brief, it is possible by the use of sorting and tabulating machines to obtain any desired combination of the information punched on the sales statistical cards.

There is no questioning the great value in most cases of the class of sales statistical data just described. With this information focussed in a properly designed system of statistical reports and graphic charts the sales manager is given immense assistance in his work of supervising the activities of the selling force, and when such a system is first installed his delight in receiving this potent aid to the handling of his work is so great that he is apt to overlook the fact that desirable as are the data with which he is furnished the most important information of all is absent. Business is not conducted for the purpose of making gross sales, but with the object of making profits, yet there is probably not one sales statistical system in a hundred, nay in a thousand, which in addition to furnishing all of the information mentioned above as to the sales can also give it as regards *profits*. What is the inevitable result? The only complete information available being that as regards the volume of sales the efforts of the whole sales department are directed primarily to volume of sales rather than to profit. Salesmen are paid commissions on their gross sales, not on the profit they make, with the result that the most highly regarded salesmen is often

the one who by shading prices piles up the greatest volume of business. The sales manager having nothing to guide him other than the figure of gross sales is naturally influenced by volume more than anything else and this attitude permeates down the line. Even when prices are determined by the head office it is often the case that different discounts are made to the different classes of customers, the larger buyers receiving the most favorable discounts, so that with information as to profits made by the individual salesman not being available he naturally follows the line of least resistance and neglects the smaller but relatively profitable customer in order to swell his volume of sales by selling to the large but relatively least profitable customer. The author calls to mind one case where he introduced a system of cost accounting which furnished information as to the profits realized by each salesman, with the result that before very long the salesmen materially modified their views and tactics, as they found that it was more profitable for themselves and their company to give much more attention than formerly to the moderate purchaser whose business in reality was the most profitable.

The limitation of the scope of sales statistics is in most cases due to the inefficient methods of cost accounting employed, for under the detailed cost methods followed, when the sales items are at all numerous the expense involved in obtaining the cost of sales would be excessive and under the cost plan usually followed where costs are only determined at the close of the month it is necessary to wait until after the compilation of the cost figures for the month before the costs on the individual sales can be figured.

It is distinctly remarkable how little valuable information is furnished the average sales manager even in those concerns where there is a more or less elaborate cost system and where numerous cost clerks are employed. In the case of a company whose product was sold on an f. o. b. Pittsburgh basis and where the freight item was a factor of great importance, it was not possible in spite of the highly detailed cost accounting system in force to determine whether the business done in territories where the company was not reimbursed for freight outlays was being handled at a profit or otherwise.

Fixing Responsibility

The average accounting system does not distinguish between profits due to the efforts of the sales department and those result-

ing from economies effected by the manufacturing division, with the result that a poor showing is generally attributed by one division to the shortcomings of the other. Perhaps one of the most valuable features of the methods of cost accounting described in this volume may be said to be the facility with which a clear line of demarcation can be drawn between the operating and sales divisions so that responsibility for a poor showing or credit for a good one can be directed to the division responsible.

Comparatively little attention has been given by cost accountants generally to analyzing the costs of selling and distribution, and when the elaborate methods which are often employed in the compilation of labor costs are considered and the fact that these costs often total to far less than the costs of selling and distribution the scant attention given the latter would seem to indicate the lack of a sense of relative values. There would seem to be little question that greater possibilities for economies exist in the field of sales expense than in that of factory labor and the compilation of adequate data relative to the cost of the former is the first step toward the effecting of economies in this direction. No system of accounting can be considered complete which does not provide for the preparation of separate profit and loss accounts for each salesman, these accounts showing on the one side the salary, commission, and expenses of the salesman and on the other the gross profits realized from the sales made by him. The objective of the salesman under these conditions will be the earning of net profits and not merely volume of sales.

So far as the author is aware no method of accounting has yet been developed other than that described in this volume by which the complete system of sales statistics enumerated earlier in this chapter can be obtained economically and with promptitude when the product manufactured is of diverse character and of extensive variety. Under the usual detailed methods of cost accounting where the line of articles manufactured may total several thousands it would be practically an impossibility to obtain prompt and accurate distributions of profit by salesmen, territories, etc., even if the cost of this, which would be great, were not regarded as a deterrent. By the use of standard or specification costs, however, such information can be obtained with facility and economy.

Figuring the Cost of Sales

One of the difficult cost accounting problems to be solved in a business where a multiplicity of product is manufactured is that of providing the means for ascertaining the cost of the goods sold, which process is obviously a prerequisite to the figuring of the profit or loss realized on sales. The problem in this respect is often not so much the determination of methods which are theoretically correct but the provision of means whereby an immense number of sales items can be reduced to a cost basis without demanding too great a volume of clerical work, and in the determination of the best method to apply to meet any particular case is one that calls for the exercise of judgment and ingenuity on the part of the designer of the cost system.

In the preceding chapters various methods for determining the cost of sales were illustrated—all of these being based upon the same general idea of providing means for reducing the goods sold to a standard cost basis, the standard cost of the goods sold in turn being adjusted to the basis of actual cost by the use of the ratios of actual to standard cost appearing on the inventory controlling accounts.

A simple illustration of the application of this principle was given in Chapter II (see Figure 3) where the standard cost of 10,000—3¼ inch by ⅝ inch hexagon head machine bolts was made up as follows:

Material	$66.60
Labor	13.14
Burden	31.05
Total	$110.79

It was assumed in the illustration given that the sales of these machine bolts in the month totalled 2,000,000 pieces, the standard cost of these sales being figured as follows:

	Standard Cost of Sales of 2,000,000 Bolts
Material	$13,320.00
Labor	2,628.00
Burden	6,210.00
Total	$22,158.00

The ratios of actual to standard cost for material, labor and burden were as follows:

Material	107.00 per cent
Labor	105.60 per cent
Burden	113.80 per cent

and applying these ratios to the standard cost of the month's shipments, as shown above, gave the following actual costs of the 2,000,000 bolts shipped during the month:

	Actual Cost of 2,000,000 Bolts Shipped
Material	$14,252.40
Labor	2,775.17
Burden	7,066.98
Total	$24,094.55

The amount realized from the sales of the 2,000,000 bolts was $26,000.00 so that the profit on sales was figured as follows:

Amount of sales	$26,000.00
Cost of Sales	24,094.55
Profit	$1,905.45

In the case just given it was assumed that the business was confined to the manufacture of one item of product, this comprising a single piece of metal—a condition of extreme simplicity not often to be met. The general principle used in this case, however, can be successfully applied to meet the most complex conditions, rendering it possible to obtain promptly and inexpensively accurate information as to the cost of sales in cases when the product manufactured runs into the tens of thousands of different articles and the sales items in a month into the hundreds of thousands. It is under such complex conditions as these where the need for accurate information as to which lines are being marketed profitably and which not is of vital importance that the average system of cost accounting hopelessly breaks down and the author claims, and he believes with

justice, that in these highly complex cases the desired results cannot be obtained by the use of the commonly accepted methods of cost accounting under which a detailed cost is carried for each item of product manufactured and the individual sales items figured at this cost. Theoretically, such a method will give the required information but the volume of cost accounting involved is necessarily so great as to render the undertaking one of prohibitive expense.

Figuring the Cost of Sales of Complex Machinery

In Chapter III (see Figure 5) there was illustrated the application of the standard cost idea in the determination of the cost of sales of machinery comprising numerous parts, part-assemblies and main assemblies composed of many different kinds of materials. In this case the machine taken as an example is a windstacker for a thrashing machine and a more elaborate classification is made than the simple division into material, labor and burden used in the illustration of machine bolts. The purpose of this elaboration of the cost classification will be obvious when it is remembered that in the case now being considered it is assumed that the manufacturer is producing a variety of machines and that the proportions of the different classes of material and labor in the different kinds of machines may vary considerably—in one machine, for instance, 50 per cent of the material cost might be for lumber whereas in another case practically no lumber would be used. Under such conditions if it should happen that the fluctuation in the purchase price of lumber varies materially from the fluctuations in the price of other materials it is obvious that this fluctuation in the price of lumber should be apportioned to the articles using lumber and not spread over all articles, which would be the case if one material adjustment factor were used. In a similar manner, if accuracy were desired in the cost of sales information, variations in the carpenter shop labor and burden would require to be absorbed in the cost of articles involving work in the carpenter shop.

As illustrated in Figure 5, therefore, the standard cost of the windstacker is analyzed into main classes of material, labor and burden, the total standard cost of $61.16 for this windstacker as shown in Form C on Figure 5 being made up as follows:

Material		
Lumber	$15.43	
Galvanized iron	3.75	
Gray iron castings	5.40	
Bar iron	2.50	
Paint	1.80	
Misc. material	10.37	
Total		$39.25
Labor		
Carpenter shop	$3.41	
Machine shop	0.86	
Forge shop	0.23	
Paint shop	0.80	
Tin shop	1.14	
Erection shop	1.75	
Total		$8.19
Burden		
Carpenter .....100 per cent....	$3.41	
Machine .....150 per cent....	1.29	
Forge .....125 per cent....	0.29	
Paint .....125 per cent....	1.00	
Tin .....150 per cent....	1.71	
Erection .....110 per cent....	1.93	
General ..... 50 per cent....	4.09	
Total		$13.72
TOTAL COST		$61.16

The method of reducing the shipments of these windstackers to a standard cost basis is illustrated on Form J of Figure 5, this work being reduced to a minimum by having the description of the machine and the standard cost per machine for each class of expense printed on the sheet by means of a duplicator, the actual clerical work required each month then being limited to posting the number of machines shipped and multiplying the standard costs per machine for each class of expense by the number of machines shipped—a speedy operation if a calculating machine is used.

In the illustration given in Form J on Figure 5 the reduction of the standard cost of the machines shipped to an actual cost

basis was made for all the machines shipped in total but the figuring of this for the individual machines would merely involve a slight addition to the clerical work. For instance, it was assumed that the number of windstackers shipped in the month totalled 50 and the statement shown in Table 22 illustrates the calculations involved in the determination of the actual cost of these windstackers and the profit realized on their sale. This method of figuring cost of sales, which the author originated and has introduced into numerous factories, some of which manufacture several hundred different types and sizes of machines, is the only means of which he is aware by which accurate information relative to the cost of sales can be obtained without requiring the carrying of the immense number of cost accounts demanded by the usual detailed cost methods. It may be well to state at this time that under the usual cost methods, there is required a separate account for each part, part-assembly and main assembly and the methods also involve the posting of every time ticket, and material requisition to an individual part or assembly account and the laborious figuring of the average costs of each part each month so that the part accounts may be credited and the assembly accounts charged with the cost of the parts used in the month's assembly operations.

It is probable that the immense volume of clerical work demanded by the usual detailed methods of cost accounting is the main cause underlying the failure on the part of many manufacturers to figure monthly the cost of the goods they sell. It has apparently never occurred to many exponents of cost accounting, that there is something radically wrong in a theory which assumes that the same methods of cost accounting should be applied to the business of a manufacturer turning out thousands of identical machines in a month as would be desirable for keeping track of the cost of building a court house or constructing the Panama Canal. It would probably greatly surprise the average reader if he knew how small is the percentage of manufacturing concerns obtaining really complete and reliable information as to the profits realized on the various articles they manufacture. As a matter of fact, the failure of manufacturers to obtain this information in the majority of cases would seem to be due not so much to a lack of appreciation of its importance but to a carefully arrived at decision that valuable as this information may be it is doubtful whether it is worth the immense amount of clerical expense which is necessary to furnish it under the methods of cost accounting commonly employed. Quite

TABLE 22. COSTS AND PROFITS FROM SALE OF 50 WINDSTACKERS

	Standard Cost of 1 Windstacker	Standard Cost of 50 Windstackers	Ratio Actual to Standard Cost	Actual Cost of 50 Windstackers
MATERIAL				
Lumber	$15.43	$771.50	115.3	$889.54
Galvanized iron	3.75	187.50	102.6	192.38
Gray iron castings	5.40	270.00	108.8	293.76
Bar iron	2.50	125.00	101.4	126.75
Paint	1.80	90.00	138.5	124.65
Miscellaneous material	10.37	518.50	107.6	557.91
Total	$39.25	$1962.50		$2184.99
LABOR				
Carpenter shop	$3.41	$170.50	109.9	$187.38
Machine shop	0.86	43.00	97.9	42.10
Forge shop	0.23	11.50	100.8	11.59
Paint shop	0.80	40.00	107.2	42.88
Tin shop	1.14	57.00	92.8	52.90
Erection shop	1.75	87.50	87.1	76.21
Total	$8.19	$409.50		$413.06
BURDEN				
Carpenter shop	$3.41	$170.50	114.8	$195.73
Machine shop	1.29	64.50	106.9	68.95
Forge shop	0.29	14.50	99.8	14.47
Paint shop	1.00	50.00	112.9	56.45
Tin shop	1.71	85.50	96.9	82.85
Erection shop	1.93	96.50	87.8	84.73
General	4.09	204.50	104.1	212.88
Total	$13.72	$686.00		$716.06
TOTAL COST	$61.16	$3058.00		$3314.11

Amount Billed	$3748.00
Gross Profit	433.89
Selling and Administration Expense	379.64
NET PROFIT	54.25

often the author has seen statements by advocates of cost accounting in which severe criticism is made of the failure of a large percentage of manufacturers to maintain adequate systems of cost accounting under which they can ascertain the profit and loss realized each month on the sales of the different lines manufactured. In none of these statements, however, does the author remember having seen any suggestion that the failure of manufacturers to adopt cost methods is due to defects in the accepted methods of cost accounting and not merely to the unprogressiveness of manufacturers, and his own conclusion is that in many cases the manufacturer is amply justified in preferring to have a rough and ready method of obtaining approximate costs rather than to involve himself in the maintenance of a cost department which may give him refinements of information but which costs him far more than he can ever expect to save as a result of its efforts.

The author does not wish to be understood as recommending that the manufacturer should endeavor to operate his business without the benefit of a cost accounting system, for the cost of operating a properly designed system of cost accounting should be trifling compared with the advantages which can be obtained from intelligent use of the information which such a system should furnish, but he does claim that the elaborate, expensive and inefficient methods of cost accounting with which we are all too familiar, which are masterly achievements in combining the maximum of expense with the minimum of essential information are more often a handicap to a manufacturer than an aid to him in the operation of his business.

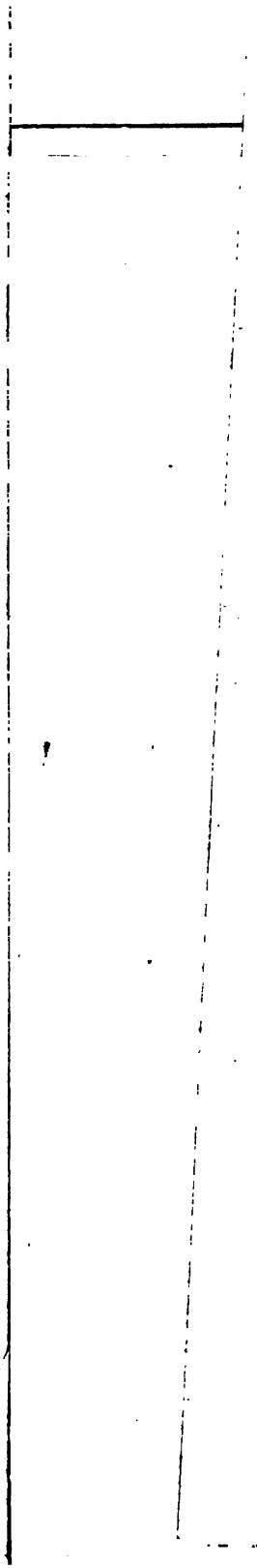
Figuring the Cost of Sales for an Exceedingly Varied Product

Probably the most difficult problem to be solved in connection with the determination of the cost of sales is in those industries where the product is of immensely varied character, such as in the bolt and nut business or in the silverware, miscellaneous hardware or allied trades where the line handled may run into the tens of thousands of items. In these industries the problem is complicated by the vast number of individual sales items which render prohibitive the expense of any system of accounting which necessitates the costing of each sales item as would be necessary under the usual forms of cost accounting.

The difficulty of the problem of ascertaining the cost of sales in the industries mentioned has been such as to generally result in no attempt being made to figure monthly profits and losses and in fact in the great majority of cases the profits are not ascertained until the time of the annual inventory and even then are only obtained in total, it being impossible under the usual forms of cost accounting to determine how much money was made or lost on the sales of individual lines.

By the use of the methods of standard cost accounting described in this volume it is however possible not only to obtain monthly information as to the profits and losses realized on the different lines sold, but to obtain important refinements of this information—to know, for instance, the profits and losses on the sales of each line by each salesman, in each territory and to the different classes of customers. Furthermore, which is of vital importance, this information can be obtained quite inexpensively and in fact in the numerous cases where tabulating machines are used for the purpose of obtaining sales statistical data very little additional expense is involved in extending the scope of this statistical work to embrace the work of determining the profit and loss on sales.

Though the "list less discount" method of selling goods cannot perhaps be regarded as an entirely unmixed blessing it is without question a valuable aid to the conduct of business. Originally it was probably the conception of some canny merchant with whom necessity was the mother of invention and who having a large supply of catalogs on hand at a time when he wished to make a general revision of prices scratched his head to find some way in which he could avoid the reprinting of his catalogs and conceived the brilliant inspiration of having a sticker inserted in the catalog on which were printed the now all too familiar words "all prices in this catalog increased ten per cent!" So useful a device could hardly fail to become widely adopted, particularly in industries, such as miscellaneous hardware, in which the number of items handled by a merchant or manufacturer would run into the thousands and the number of trades now making use of lists and discounts is legion. It would be difficult in fact to conceive of business during the last few years with the continuous upward trend in prices being handled without the list and discount plan though it may be suggested that the inexpensive revised discount sheet has not been altogether a benefit to the world at large and that if manufacturers had been compelled to reprint their complete catalogs



every time they wished to pass the burden along to the ultimate consumer they sometimes might have paused a little longer before raising prices.

The list less discount idea has proven to be remarkably workable. The originators of some of the standard price lists probably never anticipated the condition which has developed in some industries where the discounts gradually declined to the vanishing point and then retired in favor of "list plus premium" but figuring prices from the list when premiums are used is a little more convenient even than figuring with discounts so that, like the principle of standard costs, the essential soundness of the list and discount idea is proven by the facility with which it can be adapted to meet varying and unexpected conditions.

Many years before he developed the application of the standard idea in cost accounting with which this volume deals, the author pondered on the possibilities of using the standard price lists as a means of determining the profits and losses realized on sales of different lines, but without the assistance of standard costs he made little headway. There were many complications—for instance there was not necessarily any direct relation between the cost of different articles and their list prices. Also owing to improved methods of manufacture certain classes of goods or certain sizes of goods could be manufactured more cheaply than at the time the list was made while other classes or sizes of goods cost as much as before, but the list would not be changed, the alteration in conditions being merely reflected in the use of different discounts for the different classes of product or groups of sizes. In some industries different price lists were used for the various classes of customers—class A customers, for instance having a slightly lower price list than class B, and so on. By the use of standard costs, however, and the exercise of a certain amount of ingenuity the author found that it was possible to devise methods which would successfully meet all of these problems. Some of these methods are described in this chapter.

In Figure 20 is diagrammed a plan which illustrates the general principles involved in the determination of the cost of goods sold and the figuring of monthly profits and losses by lines by the use of price lists combined with the application of the standard cost idea. The particular plan illustrated is not suitable to meet all conditions, even when sales are made on a list less discount basis, but a thorough understanding of this plan should enable a skilful accountant to apply the principles

involved to meet other situations, and at this point it would seem well to mention that he who thinks he can successfully apply any system of accounting which he sees in a book to meet other conditions without possessing a thorough understanding of the basic principles involved is headed for trouble. The author realizes that in making this statement he is probably going contrary to the views of the engineer quoted in the first chapter to the effect that an expert on shop management in a short time can learn all the accounting required to enable him to satisfactorily design systems of cost accounting and that the employment of an expert accountant for this purpose is an absurdity. Though an accountant by profession, the author holds no brief for expert accountants as designers of cost systems and in fact in this volume has been frank to criticize the accounting profession for its shortcomings in this field, nevertheless he considers that some of the claims which are made that engineers should be masters as well as jacks of all trades are not founded on common sense, nor are to the benefit of the engineering profession, and that the logical exponents of accounting methods are those who have devoted their lives to this work. Accounting is deceptively simple on the surface—like chess it is founded on a few simple principles but its combinations are innumerable and there is as much difference between the cost systems which an engineer with a superficial smattering of accounting knowledge and a highly trained accountant would design as there would be between the chess game which would be played by a novice who merely knew the moves and the masterpieces of Paul Morphy.

The information which a cost system should furnish should form a trinity of cost data, efficiency data, and cost of sales data. As a general rule the systems of cost accounting which are designed by professional accountants while meeting at least partially the first and third requirements ignore the second but they at least conform to established accounting principles and furnish proper control of the cost records through the general books. The cost systems as a rule drawn up by engineers furnish considerable information relative to manufacturing efficiencies but this information is rarely brought to a focus and neither this nor the cost data are properly controlled by the general books, with the result that it is difficult to prove or disprove the correctness of the information submitted, and provision for accurately figuring cost of sales except in the simplest situations is generally entirely absent. These three major requirements

of a cost system are not three separate problems but merely different angles of the same problem and under a properly designed cost system the methods used to satisfy one of the requirements should enable the remaining two to be also met. A cost system should be a stone to kill three birds.

The absence of means for determining the cost of sales and the profit and loss by lines monthly is so common and so serious a defect in the cost systems operated by manufacturers of a varied line of product that at the risk of being tedious the author considers it desirable to enter into a somewhat lengthy explanation of the plan diagrammed in Figure 20. In this diagram in order to facilitate exposition the forms are given distinguishing letters while the lines, depicting the various accounting operations involved in the plan are numbered, the descriptive comments to follow being arranged in the order of the forms.

Form A—Making Work in Process Account

At the outset it should be mentioned that the plan being described was designed to meet the requirements of a business manufacturing silver-plated goods of great variety, these goods being carried on the stock shelves in an unplated condition until required for shipment, whereupon the goods (known as "metal stock" and so referred to in the diagram) would be taken from the stock room, sent through the plating room, buffing and other finishing operations performed on them and the goods then boxed and shipped. The operations up to metal stock are known as "making operations" and from metal stock to shipment as "finishing operations."

It was necessary for this system to show the profit and loss realized monthly on the sales of about twenty different lines and a condition which required to be considered was that articles in the earlier operations were not identifiable with the line of which they would ultimately form part, blanks in various stages being carried in stock which could be worked into articles belonging to several lines. Under these circumstances it was decided not to attempt to carry separate making work in process accounts by lines but to carry all making work in process in one main account, subdividing this into:

1 Metal
2 Making labor
3 Making burden
4 Merchandise
5 Die service

The making work in process account is charged with the cost, both actual and standard, of all making operations performed the method employed following the lines illustrated in earlier diagrams (see Chapter II—Figure 3, Chapter III—Figure 5 and Chapter IV—Figure 7) this in general resolving itself into posting the actual cost of metal, labor, burden, and die service to the "actual" column of the respective divisions of the making work in process account and figuring the production on a standard cost basis and posting the figures so obtained to the "standard" columns under the same divisions of the making work in process account.

The making work in process account is credited with the actual and standard cost of the goods transferred to the metal stock shelves as ascertained from the summary of metal stock transfers (Form C), the standard cost of the goods transferred (divided as to metal, labor, burden, and die service) being obtained by sorting and tabulating the metal stock transfer cards (Form H). The actual cost of the goods transferred to metal stock is obtained by applying the ratios of actual to standard cost as appearing on the making work in process account (See line 4—Form A).

Form B—Finishing Work in Process Account

This form serves the same purpose as regards the finishing operation as the making work in process does for the making operations. The credits to the finishing work in process account —representing the standard and actual cost of the finishing operations on work received into finished stock—are obtained through the medium of the summary of finished stock transfers (Form D), the standard cost of the finishing operations being obtained through the sorting and tabulating of the finished stock transfer cards (Form J), the actual cost of the finishing operations on the goods transferred to finished stock being figured by applying the ratios of actual to standard cost as appearing on the finishing work in process account. (See Line 9—Form B).

Form C—Summary of Metal Stock Transfers

The purpose of this form was explained above when dealing with the making work in process account. The operations in-

volved in the use of this form as illustrated by the lines on the diagram are as follows:

Line 3—Sorting metal stock transfer cards by line number and tabulating for standard metal, labor, burden, merchandise, and die-service. Posting totals so obtained in the various standard columns

Line 4—Posting ratios of actual to standard cost from respective divisions of making work in process account (Form A) to head of columns

Lines 5 and 6—Applying these ratios to standard figures previously obtained (see line 3, above) to obtain actual cost of transfers to metal stock and carrying actual and standard cost for the line in total to metal stock account (Form E) Table 23 should make the above operation entirely clear

Line 7—Obtaining total actual and standard cost of metal stock transfers for all lines and posting to credit of respective divisions of making work in process account.

Form D—Summary of Finished Stock Transfers

This form serves the same purpose for the finished stock transfers that the summary of metal stock transfers does for the metal stock transfers. The operations involved in the use of this form as illustrated by the lines on the diagram are as follows:

Line 8—Sorting finished stock transfer cards (Form J) by line number and tabulating for standard metal stock, finishing labor, finishing burden, gold, and silver used in plating, paper and box, and merchandise. Posting totals so obtained as well as list price of goods finished, also tabulated, to the various standard columns of the summary of finished stock transfers

Line 9—Posting ratios of actual to standard cost from the respective divisions of the finishing work in process account to the head of the columns of the summary of finished stock transfers

Line 10—Posting ratio of actual to standard cost of metal stock for line from metal stock account (Form E) to metal stock per cent column on summary of finished stock transfers

Line 11—Applying ratio obtained in previous operation to standard cost of metal stock in finished stock transfers to obtain actual cost and posting both actual and standard metal stock cost to credit of metal stock account (Form E)

Lines 12 and 13—Applying ratios of actual to standard cost of finishing operations as obtained in operation No. 9 above to standard cost of finishing operations to obtain actual cost. Obtaining total of actual cost of metal stock and finishing operations and posting this total together with the list value of the goods transferred to finished stock to the finished stock account (Form G)

Line 14—Obtaining total actual and standard cost of finishing operations in finished stock transfers for all lines and posting to credit of various divisions of finishing work in process account (Form B)

TABLE 23. METAL STOCK TRANSFERS—LINE 5000

Item	Standard Cost as Obtained from Tabulation of Metal Stock Transfer Cards	Ratio of Actual to Standard as Obtained from Making Work in Process Account, Per Cent	Actual Cost of Metal Stock Transferred Obtained by Applying Ratio in Second Column to Figures in First Column
Metal	$1896.00	113.17	$2146.00
Making labor	1763.00	115.27	2032.00
Making burden	2009.00	105.18	2113.00
Merchandise	83.00	104.70	87.00
Assorted die service	67.00	123.44	83.00
Pattern die service	82.00	129.11	106.00
Total standard and actual cost carried to metal stock account	$5900.00		$6567.00

FORM H—METAL STOCK TRANSFER CARD

This card represents the metal stockkeeper's report of goods received in the metal stock room. The standard cost per gross for metal, making labor, making burden, merchandise, and die service would be posted from the standard cost sheet for the

article reported as received (See line 2—Form H). This standard cost sheet is not illustrated in the diagram but follows along the lines of the standard cost sheets shown in earlier diagrams. The extensions would then be made and the cards punched.

At this point it may be well to draw attention to the importance of designing cards to be punched in such a way as to render the punching operation an entirely mechanical one. In the author's opinion a dual card (so called because both the written and punched information appear on the same card) is not properly designed if an experienced punch operator who has never seen the card before is not enabled to punch the card at full speed at the outset and without requiring any lengthy preliminary study of the arrangement. This can be easily accomplished if the matter to be punched is arranged in the same order as are the different fields and if the "shark's tooth" plan used in Forms H and J is followed. Under this plan by each item of written information to be punched are printed as many sharks' teeth as there are punching fields provided on the card. For instance on Form H five fields are provided for punching the order number and correspondingly five sharks' teeth are printed in the space provided on the card for writing the order number so that assuming for the sake of argument that the order number is 989 the operator knows immediately from the sharks' teeth that she will have to punch five fields and accordingly punches the order number as 00989.

It will be noted that the arrangement of the written data on Forms H and J proceeds from left to right in conformity with the arrangement of the punching fields with the exception of the date and the line number which are shown on the extreme right. The reason for this arrangement is that it is not convenient to crowd all of the written matter to be punched to the left of the card as those who are familiar with the particular kind of punch used will readily realize. The line number was therefore placed to the extreme right and was the first item to be punched on the hand punch, the month and day in the case being dealt with being invariably punched on a gang punch.

Form J—Finished Stock Transfer Card

The operations involved in handling this card are practically identical to those required for the metal stock transfer card.

The standard costs per gross are obtained from the standard cost sheets which in addition to showing the standard cost carry the list price of the goods which is also posted to the finished stock transfer card.

Form E—Metal Stock Account

A separate metal stock account is carried for each line, the main purpose of this account being to furnish the ratio of actual to standard cost for figuring finished stock transfers. In addition, of course, the account is of value as indicating the amount invested on the metal stock shelves in respect to the different lines.

Form F—Sales Card

This card does not differ from the usual form of sales statistical card with the exception that in addition to the amount billed provision is also made for punching the list value of the goods sold. In most cases this information will be shown on the invoice so that the additional work involved in making up this card is trifling.

Form G—Finished Stock Account

Separate finished stock accounts are carried for each line. The main purpose of this account is to furnish the ratio of actual cost to list for each line so that this ratio can be applied to the list value of the goods sold in order to obtain their cost. In addition the account is of value in indicating the amount of finished stock carried for each line.

Form K—Statement of Profit and Loss by Lines

The information shown on this statement, namely the profit and loss made in the month on the sales of the various lines, is of course the ultimate purpose of the plan illustrated. The operations involved in making up this statement are as follows:

Line 18—Sorting sales cards (Form F) by lines and tabulating for total amount billed

Line 15—Posting list value of sales as obtained from tabulation of sales cards to credit of finished stock account and applying ratio of actual to list (as shown

on debit side of account) to list value of sales to obtain actual cost of goods sold

Line 17—Posting cost of sales as obtained in foregoing operation to column so headed on statement of profit and loss by lines

The method of obtaining the net profit by lines should be rendered entirely clear by the following statement:

Statement of Profit and Loss on Sales of Line 5000 in Month of February

Amount of Billing		$14,206.00
List value of goods billed	$19,263.00	
Ratio of actual cost to list per finished stock account for line 5000	47.9557 per cent	
Actual cost of goods billed		9,238.00
Gross Profit		$4,968.00
Less Selling and Administration Expense		2,841.00
Net Profit		$2,127.00

The Economy of the Plan Illustrated as Compared with Usual Method of Figuring Cost of Sales

The advantage of the plan illustrated in Figure 20 as compared with a cost finding system under which in order to determine the cost of goods sold by lines it is necessary to carry detailed cost accounts for each article made will be apparent when it is considered that under such a plan it would be necessary to refer to the detailed cost records for every item on an invoice in order to ascertain the last cost per unit for the article in question and then to extend at this cost figure the number of pieces billed, a procedure equivalent to repricing and extending the invoice and involving so much work as to be prohibitive in most cases on the ground of expense. Under the plan illustrated in Figure 20 there is practically no additional work in connection with the invoice with the exception possibly of totalling the list amounts but this in the majority of cases will already have been done.

Obtaining Profits and Losses by Salesmen, Classes of Customer, etc.

Under the plan illustrated in Figure 20 any subdivision of the profit and loss data can be obtained with facility—for instance the procedure required to figure the profits and losses on the sales of each line by the different salesmen would be as follows:

1 Sort sales cards by salesmen and line
2 Tabulate list and billed amounts for each line for each salesman
3 Apply ratios of actual to list (as obtained from the finished stock account—Form C) to the list value of sales to obtain actual cost of sales by lines; figure gross profits, pro-rata selling and administration expense and deduct same from gross profits to obtain net profits

Similar procedure would be followed to figure the profits and losses on the sales of the various lines to the different classes of customers or to obtain any other combination of profit and loss data. The method followed in making an analysis of profits by salesmen is illustrated in Table 24.

Special Problems in Connection with Figuring Cost of Sales by List and Standard Cost Method

It will be remembered that in the explanation of the plan illustrated in Figure 20 it was stated that the conditions to meet which this plan was designed did not render it feasible to carry the work in process accounts by lines owing to the fact that the articles manufactured could not often be identified with the line until several operations had been performed. In many cases, however, the goods will be identified with the line from the outset and under such conditions the work in process accounts should be carried by lines as this method will give more accurate results and will simplify the work in connection with the figuring of stock transfers.

In some industries it is the custom to use different lists for the various classes of customers and this condition presents no particular difficulty as regards the figuring of the cost of sales if the relationship between the different lists is uniform as regards the different articles, as for instance when the B list is uniformly 5 per cent higher than the A list and the C list uniformly 15 per cent higher. On the cost records, of course,

TABLE 24. ANALYSIS OF PROFITS BY SALEMEN AND CLASSES OF CUSTOMER—MONTH OF FEBRUARY

Salesman or Class of Customer	Line 1000				Line 5000				Total All Lines			
	List Sales	Cost of Sales	Billed	Gross Profit	List Sales	Cost of Sales	Billed	Gross Profit	Total Billings	Gross Profit	Selling and Adminis'n Expense	Net Profit
Ratio—Cost to List						47·9557						
SALESMAN												
Brown					$3082	$1478	$1989		$8436	$3093	$1687	$1406
Smith					1541	739	1421		5062	1274	1012	262
Jones					963	462	923		4499	1183	900	283
Henderson					1348	646	1065		2812	819	562	257
Thomas					1926	924	1563		6749	2001	1350	651
Wilson					2890	1386	2415		8999	2547	1800	747
Henry					4238	2032	2557		11250	4367	2250	2117
Ferguson					3275	1571	2273		8436	2911	1688	1223
Total					$19,263	$9238	$14,206		$56,243	$18,195	$11,249	$6946
CLASS OF CUSTOMER												
A					$3467	$1663	$2841		$9561	$2911	$1912	$999
B					3853	1848	3409		11811	2183	2362	179*
C					3082	1478	2273		9561	3093	1912	1181
D					2697	1293	1847		7312	2729	1462	1267
E					2504	1201	1563		7874	3096	1575	1521
F					2119	1016	1421		5624	2180	1126	1054
G					1541	739	852		4500	2003	900	1103
Total					$19,263	$9238	$14,206		$56,243	$18,195	$11,249	$6946

* Net Loss.

only one list can be used, which for the sake of illustration may be said to be the A list in which case in order to figure the cost of the sales made on the B and C lists by the use of the ratio of actual cost to A list it will be necessary to convert the B and C sales list figures to the basis of the A list. This is accomplished by providing a special field on the sales card for indicating the list used, the cards then being sorted according to list basis, the totals for each list basis then being adjusted to the basis of the A list.

Taking the example given above of the B and C lists being uniformly 5 and 15 per cent higher than the A list, and assuming that the ratio of cost to list was 45 per cent and further that the tabulation of the sales cards was as shown in Table 25,

TABLE 25. TABULATION OF SALES CARDS

List Basis	List Value of Sales on Basis Used	Billed Amount of Sales
A (base)	$5000	$3000
B	3000	2000
C	2000	1400

then the profit on the sales made on the different list bases would be determined as shown by Table 26:

TABLE 26. PROFITS ON SALES

List Basis	List of Sales	Factor to Convert List Used to Basis of A List	Base List Value of Sales	Cost of Sales 45 per Cent of Base List	Billed	Gross Profit
A	$5000	100 per cent	$5000	$2250	$3000	$ 750
B	3000	$\frac{1}{105}$ or 95.238 per cent.	2857	1286	2000	714
C	2000	$\frac{1}{115}$ or 86.9565 per cent.	1739	783	1400	617
			$9596	$4319	$6400	$2081

Unfortunately however the lists for the different classes of customers do not always bear the same relationship as regards the different articles—for instance in the silverware business it by no means follows that if the B list is 10 per cent higher for tea spoons than the A list that this same relationship will apply as regards dessert spoons and ladles. Under such conditions it is necessary to establish an average relationship between the different lists based upon the proportionate number of the different pieces which it is anticipated will be sold. This is accomplished by figuring the proportionate quantities of the different articles at the various lists and obtaining the relationship between these lists as a whole in the manner shown in Table 27.

TABLE 27. RELATION BETWEEN COST OF THREE ARTICLES

Article	Proportionate Number Sold, Gross	List A		List B		List C	
		Per Gross	Total	Per Gross	Total	Per Gross	Total
Tea spoon.....	150	$2.60	$390.00	$2.85	$427.50	$3.00	$450.00
Dessert spoon.....	45	4.60	207.00	5.10	229.50	5.50	247.50
Ladle.....	7	7.30	51.10	8.10	56.70	9.00	63.00
Totals.....	.....	.....	$648.10	.....	$713.70	.....	$760.50
Per cent of A list	.....	.....	100	.....	110.121	.....	117.343

To convert sales made on the basis of B and C lists to the basis of the A list, sales on the B list must be multiplied by $\frac{1}{1.10121}$ or 0.908092 and sales on the C list must be multiplied by $\frac{1}{1.17343}$ or 0.852202.

The proportionate numbers of the different articles sold as used above must obviously necessarily be in the nature of an estimate based upon past records and present expectations. Periodically the actual proportions of the different articles sold should be ascertained and the sales statistical records adjusted to conform with these actual results.

An Illustration of the Method of Ascertaining Profits and Losses Made by Individual Salesmen in the Agricultural Implement Industry

In Figure 21 are illustrated the essential features of a plan to meet the exceedingly complex conditions existing in the agricultural implement industry where in addition to selling complete implements a very large business is carried on in connection with the sale of an extensive line of repair parts running into the tens of thousands of separate articles.

In this diagram is illustrated the use of specification costs in ascertaining the profits and losses made by individual salesmen and the hypothetical case taken as an example is that of J. G. Jones of the Agricultural Implement Company. Mr. Jones' profit and loss account for the month of August, 1918, is shown in Form K, from which it will be seen that there was a gross profit on his sales for the month of $1103.21, which after deducting his salary, commissions and expenses, totalling $430.72, left a balance of $672.49. The proportion of general selling and administrative expense chargeable against J. G. Jones for the month (based on gross sales) amounted to $1253.17, with the result that his account for the month shows a net loss of $580.68.

In order to demonstrate the methods followed in the compilation of this profit and loss statement there are illustrated in the diagram two invoices, one for a machine sale (Form A) and the other for a sale of repair parts (Form B), different methods being followed in figuring the gross profits on these two classes of business.

The machine invoice (Form A) is first coded for the use of the operator punching the machine sales card (Form D), extracts from the code book being shown in Form C. The machine sales card (Form D) is drawn up to record the following information:

1 Date of shipment
2 Invoice number
3 Order number
4 Territory
5 Salesman
6 Class of customer
7 Branch
8 Class of machine
9 Number of machines shipped

10 Machine number
11 Amount billed
12 Freight

and is used as a basis for determining the profits and losses realized on machine sales under various arrangements, as for instance by:

Salesmen
Territories
Classes of customers
Branches, etc.

The use of this card in the diagram, however, is confined to ascertaining the profits and losses realized by salesmen, dividing these into the various classes of machines sold, as for instance:

Implements
Wagons
Carriages
Grain drills
Gas engines
Tractors
Lighting plants, etc.

Reference to Forms A, C, and D will show that the following information on the machine invoice (Form A) is coded:

	Code Number
Territory—Illinois	16
Salesman—J. G. Jones	13
Class of customer—Dealer	1
Branch—Springfield	2
Class of machine—Implement	1

These code numbers are noted on the invoice (Form A) the punch operator using these notations as a guide in the punching of the machine sales card (Form D).

The machine cards are sorted by salesmen and class of machine sold and are then tabulated as illustrated to give the following information relative to the sales of the individual salesman:

1 The number of each kind of machine sold
2 The total amount billed for each kind of machine
3 The freight billed for each kind of machine

This information is posted to the analysis of machine sales by salesman (Form H) and by reference to the standard cost cards (not illustrated but similar in form to Form C, Figure 5, see Chapter III) the standard cost of machines sold is obtained, and totalled by classes, in the case illustrated, it being assumed that the standard cost of all machines of the implement class sold by J. G. Jones was $2000. In order to obtain the relation between the standard and actual cost of this class of machine an inventory account (Form F) is carried, this account following the lines previously described and showing in parallel columns the standard and actual cost of the machines manufactured. In the case taken as an example it appears that the actual cost of the machines of the implement class carried in the Springfield Branch represented 140 per cent of standard, so that the gross profit realized from J. G. Jones' sales of implements for the month works out as follows:

Standard cost of implements sold	$2000
Ratio of actual cost to standard per cent	140
Actual cost of implements sold	$2800
Amount of implement billings	$3010
Gross profit on J. G. Jones' implement sales	$210

The method shown of figuring machine sales individually is feasible in this case as these sales are comparatively small in number as compared with repair part sales, which in a large concern may total to several hundred thousand items in a year, and accordingly some other method requires to be adopted in order to be able to figure profits realized on sales of repair parts. The method adopted is illustrated in the following forms:

Repair parts sales invoice	Form B
Repair parts sales card	Form E
Implement repair part inventory account	Form G

A consideration of these forms will show that these repair parts are billed to customers on a list less discount basis and accordingly to eliminate the refiguring of invoices the implement repair part inventory account is carried on both list and actual cost bases, the ratio of actual cost to list being shown.

The repair parts sales card provides for the punching of the repair parts class number, the list price of the repairs sold and the amount billed, and as illustrated these cards are sorted by class numbers and salesmen and tabulated to show as regards the sales for each class of repair part by each salesman:

The total list price of all sales for the class.
The total amount billed for all such sales.

According to the implement repair parts inventory account for the Springfield branch (Form G) the actual cost of these parts represented 30 per cent of list and accordingly J. G. Jones' showing on sales of repair parts of the implement class is made up as follows:

Total list value of implement repair parts sold by J. G. Jones in month	$89.00
Ratio actual cost to list per cent	30
Actual cost of implement repair parts sold	26.70
Total billed sales of implement repair parts	82.67
Gross profit	55.97

Reference was previously made to the facility with which under the standard or specification plan of cost accounting, a distinction can be made between the results obtained by the sales and manufacturing divisions and though not specifically shown on the diagram it will be easily understood that by using fixed ratios for the year in figuring salesmen's profits the element of fluctuating manufacturing costs could be eliminated from the salesmen's profit and loss statements. The difference between the costs charged against the salesmen and the actual costs would then appear as a separate item on the branch profit and loss statement. For instance, assuming that the ratio of actual cost to list for implement repair parts was fixed as regards salesmen at 26 per cent while, as noted above, the actual cost was increased to 30 per cent, the profit on the implement repair parts sold by J. G. Jones would be shown as follows:

List price of implement repair parts sold by J. G. Jones	$89.00
Ratio of actual cost to list adopted for year per cent	26
Charge to J. G. Jones for cost of sales	$23.14
Total billed	$82.67
J. G. Jones' gross profit	$59.53
Excess manufacturing cost 4 per cent of list value of sales of $89.00	$3.56
Actual gross profit on J. G. Jones' sales of implement repair parts	$55.97

Chapter IX

COST ACCOUNTING AND SCIENTIFIC METHOD

THE practical value of any science lies in the power it gives of foretelling the results which will follow from a given combination of conditions, or, as Herbert Spencer stated, "the business of science is to predict." This power of science to predict lies in the fact that the universe is subject to the operation of immutable physical laws so that if the presence of a certain combination of conditions at one time gives a certain result, the identical combination of conditions at any subsequent time will result in a recurrence of the result previously obtained. Science, therefore, involves an investigation into *causes,* the scientific conception of which is defined by J. A. Thomson as being, "the totality of the conditions in the presence of which an event occurs, and in the absence of any member of which it does not occur."

Engineering science is founded on the knowledge of the results which will surely follow certain combinations of conditions so that the naval engineer from his tables can calculate the speed of a battleship before even its keel is laid, and the electrical engineer the power which will be produced from a generator, the work upon which has not proceeded beyond the blue print stage.

The practical application of astronomical science in the art of navigation lies in the ability of the astronomer to predict the exact position of the sun or some other heavenly body in a given latitude and longitude at a given moment. The practical value of meteorology lies in the ability which it gives to predict weather conditions and of geology to predict the presence of mineral wealth before even the first stroke of the pick is made.

The Value of Prediction

The late Mr. H. L. Gantt shortly before his death indicted the science of economics for its failure to predict the tremendous catastrophe of the World War, and the resultant lack of pre-

paredness of the world outside of Germany to meet this cataclysm. We are beginning to realize that it is by this standard of being able to predict correctly, to foresee, that we must in the future appraise our sciences and our professions. The value of a lawyer lies not so much in his ability to get us out of trouble but in his counsel in keeping us out of lawsuits, in his advice before the event rather than in his assistance after we are in deep water. The old-fashioned physician still regards his duty as being limited to curing us when we have become sick, often waiting until it is too late to save his patient, whereas the modern medico makes periodical examinations of his patient's condition and brings to light unfavorable tendencies in the early stages so that steps can be taken to avert disease long before the patient is aware of any unpleasant symptoms. More American lives were sacrificed in the winter of 1918 through the influenza epidemic than were lost in the World War, yet it was stated by the proprietor of a gymnasium in New York City that of the large number of active members which comprised its clientele not a single one caught this disease. Probably more lives are needlessly lost and more property wasted through a lack of foresight than all other causes combined. The old proverb to the effect that prevention is better than cure still rings true, and whatever interest may be aroused by the result of a post-mortem is certainly not shared by the erstwhile patient.

Considered from the standpoint of the dictum of Herbert Spencer, previously quoted, that "the business of science is to predict" scientific management ranks high, for as the author stated in a previous chapter:

> Scientific management is more than a system of shop management—it is akin to a state of mind—a mental attitude. Considered in its essential features scientific management represents the use of the trained imagination in industrial life—a looking forward rather than a looking backward—the doing of things mentally before the attempt is made to perform them on the physical plane.

Briefly stated, scientific management is foresight, the predetermination of methods and results. It represents the application of the same principle in the operation of machines as is employed in their design.

Foresight is necessarily a habit with the engineer. Obviously, he cannot wait until a bridge is constructed in order to ascertain whether it will withstand the strain to which it will require to be subjected. It is, therefore, not surprising that the engineer

has readily embraced the idea of scientific management; for has not his whole training and experience been along the lines of "doing things mentally before the attempt is made to perform them on the physical plane?"

The Difference Between Accountant and Engineer

The training and experience of the professional accountant, however, is along totally different lines to that of the engineer. By far the greater proportion of the work of a professional accountant's office is auditing and investigation and after many years of continuous and exacting training in this line of work, it is not surprising that his viewpoint as regards business transactions is mainly retrospective, and that the less he is gifted with the faculty of imagination the better.

The professional accountant's viewpoint is, of course, absolutely proper as regards his work of certifying as to the accuracy of the accounts and statements recording past transactions, but unfortunately in his incursions into the field of cost accounting he has not realized that the problems here are of an entirely different order to those which are involved in the certification of the records of past transactions and has drawn up his accounting systems with the main purpose of meeting the requirements of the treasurer's department, totally neglecting to provide for the needs of the producing end of the business.

Post-mortem Cost Accounting

It is now many years since Mr. Harrington Emerson drew the attention of the industrial world to the unsuitability of post-mortem systems of cost accounting to meet the requirements of an industrial world which was gradually embracing the idea of scientific management. Since that time though he and other prominent engineers have repeated and emphasized this contention, the professional accountant with few exceptions is still providing his clients with these post-mortem methods of accounting, which though probably suitable to meet the requirements of the financial interests are hopelessly and absolutely out of harmony with the needs and viewpoint of the producing end of the business. Mr. H. L. Gantt even went so far as to state that the failure of manufacturers to repair the leak of non-production is primarily due to the fallacious methods of cost

accounting approved by professional accountants, and engineers generally seem pretty well in accord that one of the most serious drags on the industrial wheel of progress is the failure of accountants generally to appreciate the urgent need of an absolute revision of their ideas on cost accounting.

The practical value of history is the ability which it gives from a study of past events to determine what to expect in the future and the value of past records of accounting should be regarded from the standpoint of the extent to which they also enable us to exercise foresight in the conduct of our business affairs. Unfortunately, this function of cost accounting is rarely exercised, such use of cost records for this purpose as is made being more or less incidental.

As soon, however, as we reverse the usual order of things, and instead of confining our accounting work to compilations of past happenings determine our costs in advance, we find that our viewpoint on the purpose of accounts is immediately and vitally changed, for we are not only interested in what things actually cost but even more in the differences between what we figured the goods should and did cost, and forthwith we call for an analysis of these variations into *causes*.

Mr. Harrington Emerson in discussing the defects of post-mortem systems of cost accounting stated that such systems are "wholly and absolutely incorrect, mixing up with costs incidents that do not have the remotest direct connection with them, so that analysis of cost statements . . . does not lead to elimination of wastes." When, however, costs require to be predetermined and to be analyzed into causes of increases and decreases as compared with the estimates, it is obvious that if the cost accountant charges any cost account with an item of expense not properly belonging there, he will quickly be called upon to justify his action. Furthermore, cost predetermination does lead to the elimination of wastes.

The average post-mortem cost system is more remarkable for its power of concealing essential facts than for disclosing them, and it seems to the author that manufacturers in these days must be asking themselves searching questions relative to the adequacy of their cost records.

The Manufacturer's Need of Knowledge

The hectic days of the war period are over. As business settles down the manufacturer is beginning to take stock. As

a part of this process he is naturally desirous of ascertaining how he stands in comparison with the pre-war period. He is paying a great deal more for his labor, and this being a condition over which he has little if any control he accepts philosophically and charges to his customers but he does want to know whether he is getting as much work done per man hour as he was before. His repair bill is way up, which is inevitable owing to increases in the price of both material and labor, but is all of the increase in this cost of repairs due to this cause—may not some of it be due to more labor and more material being used than formerly? Conversely, is it not possible that the efficiency of his repair men may have increased, or that his machines are being handled more carefully and do not require so much repairing so that although his repair cost in total is increased, as a matter of fact, figured on the pre-war price scale his repair costs to-day are less than formerly?

There is probably not one manufacturing institution in a hundred where statements of operating costs before the war can be intelligently compared with statements of current operating costs and this remark applies also to comparisons of statements from month to month and year to year. The reason for this condition is clear. The average cost system having been designed solely for the purpose of obtaining the cost of product in terms of dollars and cents, does not provide for a complete separation of cost data into elements and, therefore, in making comparisons of costs in different periods it is not possible, without an immense amount of detailed investigation, to determine to what extent increases and decreases in cost are due to general economic causes over which the manufacturer has no control, and to variations in actual operating efficiency.

The Difficulty of Comparison

In the author's experience it is the exception rather than the rule to find any mention in a cost statement of hours of labor as distinguished from the amount paid for labor, so that in comparing a cost statement of to-day with one prepared before the war, we are not able to determine to what extent an increase has resulted from a raise in the scale of wages nor to ascertain whether the present cost in terms of labor and machine hours is greater or less than before. As an example, we may take a comparison of the cost of machine repairs to-day with the

costs of several years ago. To compare such costs intelligently we must be able to separate these into their basic elements and to segregate those elements of cost over which we have control from those which are the result of general business conditions.

If we wish to interpret clearly the repair figures shown on two cost statements we must be able to determine to what extent increases or decreases are due to variations in:

1 The number of hours of work of different classes of workmen employed
2 The average rates of pay of such workmen
3 The quantities of repair material used
4 The prices paid for such material

The above information would require to be shown not only in total but also in relation to the number of hours the machines were operating and to the work produced therefrom.

In many cost statements, however, and in fact in the great majority, repair costs are simply stated in terms of dollars and cents, and though such information may meet the requirements of the accountant in the preparation of his balance sheet and profit and loss account, it is entirely inadequate to meet the needs of the plant superintendent in his efforts toward decreasing costs of manufacture.

It is the usual complaint of the cost accountant that the operating men do not analyze the elaborate and detailed statements which he prepares for their guidance. In making this criticism he overlooks, first, that the data he presents are not sufficient to enable the right kind of analysis to be made and, second, that such analysis is the proper function of the cost accountant and not of the operating man.

The Cost of Idleness vs. the Cost of Production

The most serious defect, however, in the accepted systems of cost accounting is the failure to distinguish between the cost of production and the cost of idleness. The phenomenal growth of German industry before the war was largely due to her appreciation of the importance of keeping her factories operating at full capacity; as Henri Hauser in his illuminating book, "Germany's Commercial Grip on the World," states, Germany fully understood that:

> It is no longer the demand that regulates the stream of production, it is the plant; it is the furnace which must not be permitted to go out,

it is the machine which must continue to revolve, it is the dynamo which does not cease from transferring into electric power the energy created by coal or by water power.

As a general rule, however, cost systems do not show the cost of non-production but ingeniously saddle the machine which works with the cost of the machine which is idle. As soon, however, as our cost statements show each month the big red figure which represents the cost of non-production our manufacturers will realize that idleness is the one thing which they cannot afford. There is all the difference between realizing in a general way that reduced production means increased costs and having this fact brought to our attention each month by a definite statement of the thousands of dollars which have resulted from the idleness of men and equipment. When our accounting systems provide this information there will result a tremendous impetus to American export business, for as former Secretary Lane states:

Our industries have so grown that their output when run continuously at full time is greater than our home market will take at its best, and when times are dull there is a large surplus of unsold goods. Out of this condition has grown first the wish and then the need to obtain foreign markets. . . .

Some have known what it means to have a plant made for production lie idle, eating its head off. Sometimes it happens that there is a product one could cheaply make but which one's particular market did not want. Perhaps there is some by-product which could be made if we knew where it could be sold. For these and similar ills the door of opportunity lies open, affords a remedy. Out there beyond the wall are many men of many minds, some of whom will like what we make if we could sell it, or who can use enough of our present product to add to the output of to-day that which shall make the whole cost less per unit.

The merging of the cost of idleness with the cost of production absolutely kills the value of cost statements considered as indices of operating efficiency. Every open hearth superintendent knows that the cost standards when he is operating half of his furnaces are absolutely different to what they should be when all of his furnaces are in operation. It is no fault of his that there are only sufficient orders to take half his capacity, but the result of this factor is not shown separately in the cost records, so that comparisons of costs from month to month mean little or nothing, for the difference in legitimate costs when the furnaces are running full capacity and when only half of them are operating is probably greater than could ever result from fluctuations in operating efficiency.

Mr. H. L. Gantt presented the case of the producing end of manufacturing against the professional accountant very succinctly when he wrote:

> Most of the cost systems in use, and the theories on which they are based, have been devised by accountants for the benefit of financiers, whose aim has been to criticize the factory and to make it responsible for all the shortcomings of the business. In this they have succeeded admirably, largely because the methods used are not so devised as to enable the superintendent to present his side of the case.
>
> One of the prime functions of cost-keeping is to enable the superintendent to know whether or not he is doing the work he is responsible for as economically as possible, a function which is ignored in the majority of cost systems now in general use.

It is quite obvious that for a cost system to "enable the superintendent to know whether or not he is doing the work he is responsible for as economically as possible" it is necessary for us to distinguish between expenses for which the superintendent is directly responsible and those over which he has no control, and further in order to be in a position to state whether he is producing as economically as possible it is obvious that we require standards for all expenses so that we can compare our actual expense with our standard.

Little argument is necessary to establish the fact that the usual post-mortem system of cost accounting fails totally to measure up to these requirements. The author does not deny the usefulness of the records of past experience which it is the purpose of these post-mortem cost accounting systems to furnish; he does, however, deplore the restriction of cost methods to this single end. Ralph Waldo Emerson was alive to both the value and limitations of experience when he wrote:

> Experience is hands and feet to every enterprise—yet he who should do his business on this understanding would be quickly bankrupt.

A Humiliating Situation

Illustrating the truth of this dictum the author calls to mind the case of a certain large manufacturing concern which for many years kept records showing the percentage of net profits realized on its sales and, as year after year this percentage showed no material variation, in the course of time it became the custom to use this percentage as the basis of figuring the profits from month to month. This procedure was adopted in

figuring the interim profits in a certain year and out of these supposed profits a substantial dividend was declared and paid without awaiting the final accounting based on the physical inventory at the close of the fiscal year. Unfortunately the directors in declaring this dividend had not taken into account the effect of important changes in conditions, with the result that instead of having realized a profit it transpired that a net loss had resulted from the year's operations and the dividend was actually paid out of capital. The dismay and humiliation of the directors of that company may better be imagined than described.

The Larger Significance of Double-entry Bookkeeping

All business transactions are dual in effect. If a trader purchases goods for cash his merchandise is increased and his cash correspondingly depleted; if he sells these goods on credit his merchandise is decreased and his accounts receivable correspondingly augmented and it is on this principle that is founded the double-entry system of bookkeeping, which is believed to have been introduced in Venice about 700 years ago and which is now practically universal. It is held by accountants that no cost system can be considered complete unless it is operated on the double-entry plan, so that the mechanical accuracy of the figuring can be determined by means of a trial balance which is a list of the debit and credit balances at a given time, the totals of which if the figuring has been correct must balance in view of the fact that every debit entry on the books should be offset by a corresponding credit and *vice versa*.

It is a somewhat extraordinary fact, however, that the larger significance of the double-entry principle has not been realized by accountants generally and that such application of this principle as has been made has been restricted in the main to the peculiarly technical feature represented by the trial balance. Considered in a broader sense the usual cost accounting methods are confined to showing one side of the account only—to recording how much was spent for labor and what it was spent for, but not whether a proper equivalent was received for the money expended—to advising as to the cost of material used, not whether it was used efficiently or the contrary. Such use as is made generally of cost data for the purpose of determining whether a proper return has been made for money expended is

merely incidental, haphazard, and incomplete. That this is so is just what might be expected in view of the fact that the accounting machinery is designed to meet the requirements of a restricted ideal and when an attempt is made to use it for a purpose for which it was never intended it is about as clumsy and inefficient as makeshift appliances generally are.

The Figuring of Standardized Operations

An immense amount of energy and tremendous investment in expensive time keeping equipment is more or less uselessly dissipated in the so-called refinements of cost distribution which are the result of a lack of appreciation of the fundamental importance of bringing the factor of equivalency into cost calculations. There seems to be a general idea that if we obtain a complete distribution of the time consumed by every workman our cost problems will be solved, whereas in many cases the more complete and elaborate such distribution is the farther away we get from the results desired owing to the impossibility under the methods employed of digesting the tremendous volume of detailed information compiled. The author has been in factories where an operator would work on as many as 30 short-time operations in one day, each change of work necessitating the stamping of the time on the card for the job just completed and the issuing and stamping of another card for the succeeding job. Under such conditions it may easily be imagined how little actual use can be made of the information recorded considered from the standpoint of determining whether a proper return was realized from the money expended.

The author is by no means prejudiced against the employment of time clocks and in fact would be loath to prescribe methods for a concern which was opposed to their use, but he is emphatically out of sympathy with the idea of figuring the cost of every performance of standardized operations on standardized products when the same operations are being performed over and over again, generally on a piece-work basis. And yet there are innumerable cost systems where this idiotic procedure is continuously followed, resulting in the employment of an army of clerks producing information of practically no real value and to this end adding to the high cost of living.

It is not only the expense and waste of time involved in such methods of cost accounting which are to be deplored, but the

more serious thing is that such methods, in spite of their expense, do not give adequate results. The simple, sensible way to keep track of labor costs is to set time standards for each operation and instead of recording the time spent by an operator on every job he performs during the day to compare his total time for the day with his production figured in terms of standard time. Under such a method all that is required in the form of time clocks is a regular in-and-out clock recording the actual time spent on the premises, and a record of the work which the man produces. This method eliminates the temptation to the workman to equalize the time spent on jobs by undercharging one at the expense of another and gives the real information required, namely, his relative efficiency, this being expressed as follows:

Actual time spent.....	10 hours
Work produced in terms of standard....	7 hours
Efficiency	70 per cent

It may be asked very pertinently how, under this method, labor costs can be distributed to the various articles manufactured. Before this is explained it will be well to dispose of the favorite fallacy that if John Jones, who is working on day work and not feeling well this morning, spends twice as long on a job as he would if he had not been out late the night before this extra cost is a legitimate charge to the particular article on which he is working, and that extra pay for overtime should be charged to specific articles, even if the need for working overtime is a general one and the decision as to which work is to be done in the regular time and which in the overtime period more or less fortuitous. The author claims, and believes that in this he will be supported by most practical men, that such increases over the normal cost should be regarded as charges against the product in general and not against the unfortunate article which happens to come along at the time when the cost increasing event occurs. More important still, even if such extra expense is ultimately merged in the product, which generally results in its significance being entirely lost sight of, it should first show clearly on the records and cost statements as a special expense, for owing to the inducement of extra pay it is by no means unusual for overtime to be worked unnecessarily.

The Method of Distributing Labor Costs

The air having been cleared as to the basic principles of labor distribution, the author will now proceed to explain the methods followed by him in distributing labor costs to the product manufactured without adhering to the customary procedure of keeping careful track of the time spent by an operator on every job he performs and distributing this to the cost of the different articles manufactured. As to whether the distribution of labor costs to the product should be made by specific articles or classes of product depends upon the individual conditions, but the general principles will be made clear if the latter case is taken as an illustration, for instance that of a manufacturer of agricultural implements who desires to ascertain the profits realized from the sales of the different classes of machines manufactured by him, such as corn planters, grain drills, cultivators, harrows, etc.

For the purpose of obtaining costs of sales no distinction need be made on the cost accounts as regards how much labor was expended in the forge shop on the different classes of product, all forge shop productive labor being in total carried on a forge shop labor in process account which would appear as shown in Table 28.

Table 28. Forge Shop Labor-in-Process Account

Item	Actual	Standard	Ratio Actual to Standard Per Cent
Balance forward	$1820.00	$1400.00	130
Charge for month	931.00	700.00	133
Total	$2751.00	$2100.00	131

To obtain the cost of the corn planters shipped during the month (as regards the element of forge shop labor) necessitates determining the standard forge shop labor per corn planter, this multiplied by the number of machines shipped giving the total

standard forge shop labor in these shipments. This standard labor is adjusted to an actual basis by the use of the ratio of actual to standard of 131 per cent as shown in Table 28.

Assume for instance the standard forge shop labor cost per corn planter to be $1.00 and the number of corn planters shipped in the month 500, the calculations would be:

Standard Labor	Ratio Actual to Standard per cent	Actual Labor in Shipments
$500.00	131	$655.00

The forge shop labor-in-process account would then show as in Table 29, the balance carried forward representing the forge shop labor cost of all goods remaining unshipped:

TABLE 29. FORGE SHOP LABOR-IN-PROCESS REVISED ACCOUNT

Item	Actual	Standard	Ratio Actual to Standard Per Cent
Total as above (Table 28.)	$2751.00	$2100.00	131
Shipments	655.00	500.00	131
Balance carried forward	$2096.00	$1600.00	131

Reverting to the major theme, namely, the fundamental importance of the factor of equivalency in cost accounting—the opening of the other side of the ledger and the rendering of cost accounting double-entry in the fullest and most vital sense —it may be stated, that it is only along these lines that cost accounting will ever fill its proper place in the economic structure, for records of actual costs without parallel statements of standards are as incomplete as a trial balance which shows only the debits and ignores the credits. Parallel statements of actual and standard costs demand an analysis of increases and decreases and when this is furnished the problem of increasing efficiency is more than half solved, for the difficulty in the average manufacturing plant is not so much in the correcting inefficiencies

after their existence has been disclosed as in ascertaining exactly where to start on the work of cutting costs.

The author has already pointed out how completely the underlying idea of scientific management conforms to Herbert Spencer's dictum that "the business of science is to predict" and how far the usual methods of cost accounting fall short of being scientific considered from this standpoint. But the power to foresee is not the only aim of science, as one writer states:

> The ultimate ideal of science . . . is simply the description of the course of events by the aid of the fewest and simplest general formulas.

Cost accounting has not as yet realized this ideal. There are plenty of forms but few formulas, in fact the only cost accounting formulas that the author remembers having seen in print were some simple formulas devised by Mr. Emerson and that given by the late Mr. Gantt in his book entitled "Organizing for Work" when he stated that:

> The indirect expense chargeable to the output of a factory should bear the same ratio to the indirect expense necessary to run the factory at normal capacity, as the output in question bears to the normal output of the factory.

Formulas represent the boiled down experience of the ages, as Ralph Waldo Emerson wrote:

> The memory disburdens itself of its cumbrous catalogues of particulars, and carries centuries of observation in a single formula.

Engineering is an exact science and the work of that profession is largely founded on formulas so that when the engineer finds himself in the domain of cost accounting he is naturally surprised to discover so much opinion and so little in the nature of facts and to crave definite basic formulas like that given above. Accountants are too prone to quibble over non-essentials. The author remembers a discussion some years ago which was waged in a leading accounting journal, and which covered many pages which could have been devoted to better things, on the subject of whether it is more correct to head a profit and loss account "for the period *ended* December 31," or "for the period *ending* December 31," and he has never seen much point to the everlasting arguments as to whether interest should or should not be included in costs, probably mainly due to the fact that under the methods he employs costs can be easily stated both ways and those with pronounced views on the subject can take their choice and be happy.

Cost accounting at present has reached about the same stage as the process of photographic development had a few years ago when the approved practice for preforming this operation was to close oneself in a stuffy darkroom where in dim red light, the photographic enthusiast would mix equal parts of solutions one and two and wait anxiously for the appearance of the the photographic image. If this did not appear as quickly as he thought it ought to he would add an extra quantity of solution number two and by this and other methods endeavor to stimulate the development of the picture. After the image appeared he had to use his judgment when to stop developing, with the result that generally the picture was either over or underdeveloped, to say nothing of the damage to the film resulting from the various manipulations performed. The whole process was wasteful of time, temper, and chemicals, the results were generally far from satisfactory and the amateur had to be very enthusiastic indeed to wish more than once to undertake the development of pictures. Nowadays, by means of a tank, a thermometer and a time and temperature table a dozen exposures can be developed in less than 15 minutes without ever even going into a dark room and with practically perfect results.

The author has previously dealt at some length with the common fallacy "that the primary purpose to be aimed at in any system of accounts is extreme simplicity of design." As Mr. Benjamin A. Franklin suggests, however, a cost system should be "a panorama of the movement and groupings of shop events" and a cost system must necessarily be complex about in proportion to the complexity of the events which it attempts to portray. As the author stated in an earlier chapter:

> There is no way of avoiding considerable complexity in the design of systems to efficiently handle a complex business, but the complexity should stop right there, for a system which is unduly difficult to operate is to that extent defective in design.

When in addition to providing the data obtained under the usual cost methods, namely, costs of specific articles and costs of goods sold, a comparison of all expenditures with standard and an analysis of variations according to "causes" are also furnished by the methods developed by the author, extreme simplicity in design is a practical impossibility. If simplicity of design were the only ideal in locomotion, however, the world would still be using wheelbarrows in place of automobiles.

Complexity in Design: Simplicity in Operation

The author is hoping that at this point the attentive reader will ask the question that the above remarks have been leading up to, namely "How is it possible to combine complexity in the design of a system with extreme simplicity in its operation?" The answer has already been suggested. The result is obtainable by the use of formulas. Under the methods developed by the author by the aid of formulas the most complex cost analyses can be accurately and speedily made by any clerk who can read, write, add, and subtract, and without any fuller understanding of the principles underlying the methods followed than the average girl in a cost department who uses a slide rule has of logarithms.

As an illustration of the use of formulas to render the making of complex cost analyses an exceedingly simple matter, the following case has been taken:

It is assumed that it is desired to ascertain the variations between actual and standard cost and to obtain a complete analysis of these variations in the pickling department of a steel mill. It is also assumed that the production of this department at full capacity is 10,000,000 pounds a month and that the standard cost of production on this basis is figured as follows:

Producing labor, 8,000 hours at average rate of 0.60	$4,800
Steam, 100,000 b.hp. at 0.015	1,500
Electricity for Exhaust Fan, 10,000 kilowatt hours at 0.02	200
Acid, 1,000,000 pounds at 0.01	10,000
Labor in Repairs, 400 hours at average rate of 0.50 per hour	200
Material in Repairs	100
Taxes, Insurance, etc.	300
Total	$17,100

The electricity for the exhaust fan, the cost of repairs, taxes, insurance, etc., not varying directly with the production are regarded as being in the nature of fixed charges, the other items of expense being assumed to vary directly with the production. By the term "fixed charges" as used here it is not to be under-

stood that the amount of the expense will not fluctuate, for obviously in the case of the electricity used for the exhaust fan both the quantity of electricity used and the cost of producing electricity may fluctuate. For such an item of expense as this, however, if the production of the department is less than standard, even if the expense itself remains constant, there will be an increase in cost per unit of production as compared with standard, owing to the actual expense requiring to be spread over a smaller production. It is in this sense that the term "fixed charges" is used in the case of expense items coming under this head, it being neecssary to show to what extent an increase in cost is due to idle time.

The problem to be solved by the use of formulas is as follows:

Given the actual production in the month and the actual expenditures, to provide comparisons of actual and standard expense analyzing the variations between actual and standard as follows:

Producing Labor	Due to variations between actual and standard time. Due to variations between actual and standard rates.
Steam	Due to variations in the quantity of steam used as compared with standard. Due to variations in the cost of producing steam as compared with standard.
Electricity for Exhaust Fan	Due to reduced production as the fan is running continuously. Due to the quantity of electricity used. Due to the cost of producing electricity.
Acid	Due to variations in the quantities of acid used as compared with standard. Due to variations in the price paid for acid.

Labor in Repairs	Due to reduced production—otherwise the idle time factor. Due to variations in the time spent in repair work. Due to variations in the rate paid repair men.
Material in Repairs	Due to reduced production. Due to variations in the quantity of repair material used. Due to variations in the price paid for repair material.
Taxes, Insurance, etc.	Due to decreased production as compared with standard. Due to variations in the actual expense for taxes, insurance, etc.

All of the above items of information can be obtained by a proper combination of four factors:

A—The actual expense for the month

B—The actual expense figured at standard rates or prices. For instance, it will be seen by reference to Table 30 that the actual producing labor was assumed to be: 5800 hours at 0.65, making $3770, this being entered in column A. But the standard rate per hour as previously shown was 0.60, so that the actual expense figured at standard rate would be: 5800 hours at $.60, making $3480

C—The standard cost for standard production, this being the standard cost on a 10,000,000 pounds a month basis as previously shown and totalling to $17,100

D—The standard cost for actual production, this being the standard cost for standard production (C) divided by the standard production and multiplied by the actual production. The actual production in the case taken as an illustration being 7,500,000 pounds, the standard cost for this production is figured as follows:

$\frac{17,100.00}{10,000,000}$ times 7,500,000, making $12,825.00

The formulas for obtaining the different items of information required are as follows:

1 Comparisons of actual and standard in total: D-A
2 Variations in production: D-C
3 Time efficiency, expense varying directly with the production, D-B
3*a* Time efficiency when expense in nature of a fixed charge: C-B
4 Variations in labor rates: B-A
5 Variations in the quantities of material used when expense varies directly with production: D-B
5*a* Variations in the quantities of material used when expense is in nature of a fixed charge: C-B
6 Variations in the price of material: B-A
7 Variation in expense when expense varies directly with production: D-B
7*a* Variation in expense when expense is in nature of a fixed charge: C-B
8 Variation in the consumption of service production (steam, electricity, etc.) when expense varies directly with production: D-B
8*a* Variation in consumption of service production when expense is in nature of a fixed charge: C-B
9 Variations in the price of service production: B-A

The above may be boiled down as follows:

D-A Comparisons in total
D-C Variations in production
D-B Variations in expenses not of a fixed charge character:
Variations between actual and standard time.
Variation between actual and standard quantities of material.
Variations between actual and standard expense.
Variations in the consumption of such service items as power, steam, electricity, etc.
C-B Variations in expense in the nature of a fixed character:
Variations between actual and standard time.
Variations between actual and standard quantities of material.
Variations between actual and standard expense.

C-B Variations in the consumption of such service items as power, steam, electricity, etc.

B-A Variations in rates of pay, price of material or of service

So, all information required in the case chosen as an illustration can be obtained by the use of five simple formulas.

These items of information and formulas applying thereto can now be stated:

Producing Labor	Comparison in total	D-A
	Time Efficiency	D-B
	Rate variations	B-A
Steam	Comparison in total	D-A
	Consumption	D-B
	Price	B-A
Electricity for Exhaust Fan (fixed charge)	Comparison in total	D-A
	Variations in production	D-C
	Consumption	C-B
	Price	B-A
Labor in Repairs (fixed charge)	Comparison in total	D-A
	Variations in production	D-C
	Time efficiency	C-B
	Rate variations	B-A
Materials in Repairs (fixed charge)	Comparison in total	D-A
	Variations in production	D-C
	Material consumption	C-B
	Price variations	B-A
Taxes, Insurance, etc. (fixed charges)	Comparison in total	D-A
	Variations in production	D-C
	Expense	C-B

In actual practice as is shown in Table 30 the work of figuring cost variations and making an analysis thereof is therefore rendered an absolutely mechanical process as follows:

First. The list of the expense accounts and the figures of standard cost for standard production for each expense account are either printed or otherwise duplicated to avoid rewriting each month (see column C).

Second. The formulas for ascertaining each class of variation are shown at the head of the columns provided for figuring such variations—for instance, in the illustration it will be seen that the column headed "Variations in Production" has the formula D-C printed at the head of it.

Third. Each of these variation columns is given a number (corresponding to the numbers already given) as follows:

1 Comparison in total.
2 Variations in production.
3 Time efficiency.
3*a* Time efficiency for expense in the nature of fixed charge, etc.

Fourth. For each account there is printed the numbers of the columns for the variations requiring to be figured—for instance, the item "Electricity for Exhaust Fan" has the following combination: 1, 2, 8*a*, 9, meaning that for this item of expense variations have to be figured as follows:

1 Comparison in total.
2 Variations in production.
8*a* Service consumption—fixed charge item.
9 Price of service.

The formulas being printed at the head of each column, the work of figuring variations is purely mechanical.

To make it all entirely clear, the proceeding involved in figuring the variations in this one item of expense, "Electricity for Exhaust Fan," may be listed as follows:

Standard cost of standard production of 10,000,000 pounds is $200.00

Standard cost of production of 7,500,000 pounds is therefore $\frac{200}{10,000,000}$ times 7,500,000= $150.00

This is entered in column D.

Actual consumption of electricity is assumed to be 9000 k.w. hours which figured at the actual rate of .0018 per k.w. hour is..... $162.00

This is entered in column A.

Actual consumption of 9000 k.w. hours figured at standard rate of .2 per k.w. hour is..... $180.00

This is entered in column B.

Comparison of the actual and standard expense and the analysis of the variation by causes in accordance with the formula given above are then made as follows:

				Increase	Decrease
1	Variation in Total:	D-A	$150.00		
			162.00	$12.00	
analyzed as follows:					
2.	Variations in production:				
		D-C	$150.00		
			200.00	$50.00	
8*a*	Consumption:	C-B	$200.00		
			180.00		$20.00
9	Price:	B-A	$180.00		
			162.00		18.00
	Net increase as above				12.00
				$50.00	$50.00

TABLE 30. COST VARIATION SHEET—

Account	Formula Combination	A			B	C		
		Actual Quantities at Actual Rates			Actual Quantities at Standard Rates	Standard Cost of Standard Production		
		Quantity	Rate	Amount		Quantity	Rate	Amount
Production.....						10,0 0,000	pounds	
Producing labor....	1–3–4	Hours 5800	0.65	3,770 00	3,480 00	Hours 8,000	0.60	4,800 00
Steam.....	1–8–9	B.H.P. 80,000	0.016	1,280 00	1,200 00	B.H.P. 100,000	0.015	1,500 00
Electricity for exhaust fan	1–2–8*a*–9	K.W. hrs. 9,000	0.018	162 00	180 00	K.W. hrs. 10,000	0.02	200 00
Acid.....	1–5–6	Pounds 730,000	0.011	8,030 00	7,300 00	Pounds 1,000,000	0.01	10,000 00
Labor in repairs....	1–2–3*a*–4	Hours 250	0.60	150 00	125 00	Hours 400	0.50	200 00
Material in repairs..	1–2–5*a*–6			80 00	70 00			100 00
Taxes, insurance, etc.	1–2–7*a*			310 00	310 00			300 00
Totals.....				13,782 00	12,665 00			17,100 00

Wherever asterisk appears in the above

PICKLING DEPARTMENT — MONTH OF.....

D		1	2	3 & 3a	4	5 & 5a	6	7 & 7a	8 & 8a	9
				Labor Variations		Material Variations		Expense 7 = D—B	Service	
Standard Cost of Actual Production		Comparison in Total	Variations in Production	Time	Rates	Quant.	Price		Quant.	Price
				3 = D—B	B—A	5 = D—B	B—A		8 = D—B	B—A
Quantity	Amount	D—A	D—C	3a = C—B		5a = C—B		7a = C—B	8a = C—B	
7,500,000	pounds									
Hours 6,000	3,600 00	3600 00 3770 00 *170 00		3600 00 3480 00 120 00	3480 00 3770 00 *290 00					
B.H.P. 75,000	1,125 00	1125 00 1280 00 *155 00							1125 00 1200 00 *75 00	1200 00 1280 00 *80 00
K.W. hrs. 7,500	150 00	150 00 162 00 *12 00	150 00 200 00 *50 00						200 00 180 00 20 00	180 00 162 00 18 00
Pounds 750,000	7,500 00	7500 00 8030 00 *530 00				7500 00 7300 00 200 00	7300 00 8030 00 *730 00			
Hours 300	150 00	150 00 150 00	150 00 200 00 *50 00	200 00 125 00 75 00	125 00 150 00 *25 00					
	75 00	75 00 80 00 *5 00	75 00 100 00 *25 00			100 00 70 00 30 00	70 00 80 00 *10 00			
	225 00	225 00 310 00 *85 00	225 00 300 00 *75 00					300 00 310 00 *10 00		
	12,825 00	*957 00	*200 00	195 00	*315 00	230 00	*740 00	*10 00	*55 00	*62 00

illustration, red figures are indicated.

Chapter X

ESTABLISHING A SCIENTIFIC BASIS FOR COST ACCOUNTING

THE oft-quoted remark that, "a man should know something about everything and everything about something" expresses a fundamental truth. Adherence to the principle there enunciated will render it possible on the one hand to avoid the Scylla of dilettantism and on the other to steer clear of the Charybdis of narrow specialism and the horrors of the single-track mind.

This is the age of the specialist and even with minds equipped with many tracks, the bulk of the traffic carried must be restricted to certain limited trains of thought peculiar to the line of work on which the mind is mainly occupied. Herein lurks the danger of specialism, for unless the specialist sees his calling in its proper relationship to things in general he is liable to develop the single-track mind—that form of monomania which has resulted in there being some dentists who attribute all human ills to diseased dental nerves, some physicians to germs, some osteopaths to crooked spines, some physical culture experts to lack of exercise, some dietitians to improper food and some enthusiasts to the twin demons of tobacco and rum.

It is probable, for instance, that most people believe that prohibition, at least in the abstract, presents certain desirable features, but when the average sane individual reads letters in the newspapers urging that all fiction in public libraries which refers to the employment of alcoholic stimulants should be destroyed, and that all paintings in public galleries depicting depraved but apparently happy persons engaged in looking on the wine when it is red should be incinerated, the question which naturally arises in his mind is whether there must not be more insane persons at large than inside the asylums.

It might be well to mention at this point, as explanatory of the motives prompting the foregoing remarks, that the author believes he may possibly have been criticized by some for not hewing sufficiently to the mark in his dissertations on cost ac-

counting, for using valuable space in gallivanting around the universe when the space might better have been devoted to describing such purely practical details appertaining to his subject as the form which stores requisitions should take, or to discussing the merits of different methods of handling pay-rolls. Doubtless to some there is considerable charm in a work on cost accounting which wastes no time in preliminary frills, but in its opening paragraphs strikes at the roots of the matter by stating that "costs are divided into three parts—material, labor and burden," but the author ventures to question the advisability of this hurried and impetuous diving into a subject and to suggest that before thus launching himself so enthusiastically into the deep waters thereof the wise student should pause to get his bearings and then pause again.

One of the prime characteristics of the scientific mind—and though the accepted methods of cost accounting are far from being scientific, cost accounting must be regarded as coming within the realm of science—is a sense of the inter-relationship of things. As Professor J. Arthur Thomson states:

> It regards Nature as a vibrating system most surely and subtly interconnected. It discloses a world of interrelations, a long procession of causes, a web of life, infinite sequence bound by the iron chain of causality.

Whatever the world owes to Dr. Frederick Taylor—and its obligation is great—it is to Mr. Harrington Emerson that we are indebted for our conception of the far-reaching importance of the scientific management idea. To Taylor, the pioneer, scientific management was essentially a system of shop management; to Emerson, the scientist, scientific management is infinitely more than this, for to his mind, as the author reads it from a study of Mr. Emerson's published works, scientific management represents a revolution in our attitude toward life in general as well as industrially, and a light on the path which mankind must follow if it is to realize its utmost possibilities.

That great master of inductive science, Francis Bacon, wrote:

> For myself I found that I was fitted for nothing so well as for the study of Truth; as having a mind nimble and versatile enough to catch the resemblance of things (which is the chief point) and at the same time steady enough to fix and distinguish their subtle differences.

And though there were some who failed to appreciate and even scoffed at the wealth of illustration in Mr. Emerson's

books, the tremendous educational value of these writings is largely due to the vivid pictures Mr. Emerson drew and his reputation as a scientist—in the words quoted above, to his having "a mind nimble and versatile enough to catch the resemblance of things (which is the chief point)."

The Narrow Specialism of Scientific Management

It is largely due to narrow specialism that scientific management is still regarded by many of its exponents as being merely a system of shop management and that the accounting profession as a whole is still oblivious of the importance of the scientific management idea as applied to cost accounting work. It seems in fact rather remarkable to the author that considering the immense amount of time which has been devoted to cost accounting by many intelligent men, that in a subject so obviously akin to mathematical science so little attempt has apparently been made to determine whether the accepted methods conform to the recognized standards of scientific work.

In the previous chapter the author endeavored to show how in one respect, at least, cost accounting can be rendered truly scientific and quoting in part from the following remarks from the pen of J. Arthur Thomson demonstrated how the operation of the laws underlying cost phenomena could be expressed in simple formulas, and also showed how these formulas could be applied in the determination of cost variations and in the analysis of these variations according to certain underlying "causes":

> The ultimate ideal of science, or at any rate of physical science, is simply the description of the course of events by the aid of the fewest and simplest general formulæ. *Why* things happen as they do, it is now said is no proper question for science; its sole business is to enable us to calculate *how* they happen.

Obviously, as indicated in the quotation given above, the function of cost accounting as regards the determination of the "causes" of cost variations must be confined to showing the effect of "efficient causes," or "caused causes," not "ultimate causes"; to showing *how* a thing happened, not *why* it happened. It is the function of cost accounting, for instance, to show the extent of a cost increase resulting from an increase in rates of pay, but it is obviously not within the province of the cost records per se to show *why* there was an increase in rates. When

the complexity of the causes underlying the present high cost of living (and incidentally the "cost of high living") is considered it would seem as if the cost accountant were to be congratulated on the fact that there are distinct limitations to the scope of his specialty.

The Value of Cost Accounting Formulas

In the previous chapter, the illustration of the use of formulas was limited to showing their application to meet a simple example. The author, however, has recently compiled tables of formulas covering a wide range of conditions and as he finds these tables of material assistance in his professional practice he believes that they may also prove helpful to others, and accordingly with this end in view these tables are incorporated in this volume.

Serious students of cost accounting, it is believed, will be amply repaid for time spent in a careful study of these tables. They bring to a focus the result of considerable investigation into the fundamental laws underlying cost phenomena and provide the means of solving many obscure cost problems. Even if the cost methods of a business are not drawn up along the lines recommended by the writer these formulas can be used in the solution of specific cost problems as shown in the examples given.

The complete formulas are embodied in two tables—Tables 31 and 32—which require to be used in conjunction with each other. The use of these tables also necessitates an understanding of the system of symbols employed, which is as follows:

The capital letters A-H are used to indicate the different classes of accounting data which enter into the various formulas, as follows:

A indicates the actual time or material expended figured at the actual rates of pay or actual price of the material.

B indicates the actual time or material expended figured at the standard rates of pay or standard price of the material.

C indicates the standard cost for a standard working month, say of 25 working days.

D indicates the standard cost for the number of working days in the month—for instance, if there were 23

working days in the month *D* would equal 23/25ths of *C*.

E indicates the standard cost for the days actually worked in the month; for instance, if a plant or a department were closed down for two out of the 23 working days in the month assumed above, *E* would represent 21/25ths of *C* or 21/23rds of *D*.

NOTE.—In the event that the base or original standard is being used for all comparisons the term "standard cost" for *C*, *D* and *E* above refers to such base or original standard. In the event, however, that a revised standard is being used for the purpose of determining operating efficiencies, or an alternate standard is being used, or a revised alternate standard, then the term "standard cost" as used above in the explanation of the significance of *C*, *D* and *E* does not mean the basic standard but the revised, alternate or revised alternate standard, as the case may be.

F indicates the alternate standard cost of the actual production in the month, which is obtained by dividing the alternate standard cost for a standard month by the standard production for such standard month and multiplying the quotient so obtained by the actual production. By the term "alternate standard cost" is meant a standard varying from the base or original standard and set up as a gage of operating efficiency when there is some variation from the operating methods on which the base standard is formulated. For instance, the base standard may be founded on the use of coal in a furnace, the alternate standard being introduced to bring into account the change in operating standard when fuel oil is substituted for coal.

G indicates the revised standard cost of the actual production in the month when a revised standard has been introduced for the purpose of bringing comparisons for the determination of operating efficiencies into line with current operating standards. This is figured by dividing *C* by the standard production in the standard working month and multiplying the quotient by the actual production for the month.

H indicates the basic or original standard cost of the actual production in the month.

In the previous chapter in order to simplify the presentation of the idea of using formulas in determining cost variations no reference was made to the effect of using alternate or revised standards, nor was any attempt made to distinguish between the basic causes underlying variations in production, namely:

(*a*) Due to the number of possible working days in the month varying from the standard working days in the standard month

(*b*) Due to the idleness of a department or of the plant as a whole

(*c*) Due to the production of the department or plant, when operating, varying from the standard production for the operating time

The letters *A*, *B*, and *C* bear the same significance in both chapters. The letter *D* as used in the preceding chapter corresponds to the use of the letter *H* in this chapter.

The numbers *1* to *13* are used to indicate the various divisions of cost variation analysis as follows:

1 The variation in total
2 The variation due to the revision of the standard
3 The variation due to the use of an alternate standard
4 The variation in cost resulting from the number of working days in the month being more or less than the number of working days in the standard month used as a basis for figuring standard cost
5 The variation in cost owing to idle time
6 The variation due to the production per day or hour being more or less than standard
7 The variation due to fluctuations in rates of pay
8 The variation due to fluctuations in the hours worked as compared with standard
9 The variation due to differences between the actual and standard price paid for material
10 The variation in the quantity of material used
11 The variation in the price of service such as power, light, etc.
12 The variation in the quantity of service consumed
13 The variation in expense

The small letters *p*, *b*, *c*, and *d* are used to indicate the character of the expense being dealt with:

p indicates an expense tending to vary directly with the production such as most forms of producing labor
b indicates an expense which is in the nature of a monthly fixed charge such as the salary of a superintendent, or fire insurance premiums

c indicates an expense which is a fixed charge per working day as, for instance, a time-keeper paid on an hourly basis

d indicates a fixed charge per day worked as, for instance, a cleaner paid an hourly rate while his department is working, but not paid if his department is not operating even though the rest of the plant is working.

The small letters *a* and *r* indicate that some other than the basic standard is being used as a means of determining the current operating efficiency:

a indicates that an alternate standard is being used
r indicates that a revised standard is being used
ra that a revised alternate standard is being used

Table 31 gives the formulas for figuring the variations in total and due to the different causes. For instance, the formula given for figuring the amount of the increase or decrease in cost, owing to variations in the actual rates of pay (See Item 7, Table 31), or in the price of material (See Item 9, Table 31), as compared with standard is *B—A*. As explained previously, these letters indicate the actual time or material expended figured at the actual price and the actual time or material expended figured at the standard price, so that the formula *B—A* involves the following calculation: Actual expenditure at actual price less actual expenditure at standard price equals variation due to change in rate or price.

In view of the fact that the total of the cost variations by causes must equal the total variation obtained by comparing the total actual cost with the value of the production figured at standard, it follows that the mathematical calculation involved is a simple equation. This can best be shown by giving an illustration as follows:

The formula given in Table 32 for determining and analyzing the variations between actual and standard cost in the case of material in the nature of a fixed monthly charge and where an alternate standard is in force, is:

$$1 = 3 + 4 + 5 + 6a + 9 + 10b \quad .$$

Expressing the above in the complete form given in Table 31 gives the following:

$$H - A = H - F + D - C + E - D + F - E + B - A + C - B$$

The arithmetical accuracy of the equation is proven by matching the various elements as follows:

$$H - A = H - F + D - C + E - D + F - E + B - A + C - B^{*}$$

The following example illustrates the actual method of using Tables 31 and 32:

Character of Expense: Foreman paid for every working day in the month whether his department is operating or not.

Class of Expense: Fixed charge per working day, Class (c1).

Standard Used for Determining Operating Efficiency: Revised.

Formula per Table 32: $1 = 2 + 5 + 6r + 7 + 8c$

(see asterisk on this table).

Formula Expanded to Terms of Table 31:

$$H - A = H - G + E - D + G - E + B - A + D - B$$

Standard Data

Standard working days in month	25
Standard pay per day	$5.00
Standard pay per standard month	$125.00
Standard production, tons	250
Standard cost per ton	$0.50

Revised Standards

Production per standard month, tons	312.50
Revised standard cost per ton	$0.40

Assumed Actual Case

Working days in the month	23
Days department worked	21
Foreman's pay (raised to) per day	$6.00
Production, tons	260

Comparative Data

A Actual at actual: 23 days at $6.00	$138.00
B Actual at standard: 23 days at $5.00	$115.00
C Standard cost for standard month as above	$125.00
D Standard cost for actual working days in month: 23 days—23/25ths of $125.00 (*C*)	$115.00

*This equation should be written with a cancellation mark through each item.

E Standard cost for days worked in department: 21 days—21/25ths of $125.00 (*C*) $105.00
G Revised standard: 260 tons at $0.40..... $104.00
H Basic or accounting standard: 260 tons at $0.50 ..... $130.00

Comparisons

1 Comparison in total (*H-A*)	$130.00		
	$138.00		$8.00*
2 Variation due to revision of standards (*H-G*)	$130.00		
	$104.00	$26.00	
5 Variation due to idle time (department was closed down during two working days) (E-D)	$105.00		
	$115.00	$10.00*	
6 Variation due to production per day actually worked being less than standard (*G-E*)	$104.00		
	$105.00	$1.00*	
7 Variation due to change in rates of pay (*B-A*)	$115.00		
	$138.00	$23.00*	
10 Variation due to difference between actual hours per day worked and standard (*D-B*)	$115.00		
	$115.00		
Totals.....		$8.00*	$8.00*

Item *2* above would be omitted on operating efficiency statements, the data on these being normally confined to showing variations between the actual cost and the current operating standard, in this case the latter being the revised standard. The

information which would appear on the operating efficiency statement in respect to the example being dealt with would be as follows:

Actual cost	$138.00	
Standard cost (revised)	$104.00	$34.00*
Analysis of above increase:		
Idle time	$10.00*	
Production efficiency	$1.00*	
Rates	$23.00*	$34.00*

*Asterisk indicates red figures signifying increase.

Further illustrations of the use of these tables are given later.

The Purpose of Dual Comparisons

From the illustration given above it will be noted that whatever the current cost standard may be (whether alternate, revised basic or revised alternate) comparisons of actual costs under the plan followed are invariably made with both this current standard and the basic standard. As the advantage of using both the basic and current standards may be questioned, a word of explanation as to this would seem in order. In making the dual comparison provided for, two purposes are served:

1 All costs being shown in relation to the base or original standard, it follows that statements that can be compared with the same thing can be compared with one another, so that however many changes in standards may have been made in the interim between two statements comparisons can readily be made between them.

2 From the standpoint of accounting technique it is highly desirable that the cost system in force should not demand the amendment of a multitude of detailed standard costs in order to reflect changes in standards introduced to conform with current operating conditions.

All industrial engineers will appreciate the value of a plan which provides for systematically taking up in the accounts revisions in standards. As Mr. Emerson states: "Staff standards

are infinite and ever-changing. The best practice of yesterday is the laughing stock of to-day," and the author calls to mind a case in one industry where changes in design of the machinery manufactured were so numerous that the force of industrial engineers employed to figure the standards were just about able to hold their own with the force of designers figuring changes. Ultimately the latter won out and the industrial engineers with great cheerfulness transferred their efforts to a field of action of a more stabilized character.

Changes in standards are the earmarks of progress. It is stated, for instance, that about the year 1500 soldiers who used guns stood in files 37 deep; the reloading of the weapons occupied so much time that when a man had fired he passed to the rear and was not ready to fire again until the 36 men in front of him had discharged their weapons. Allowing two seconds for getting out of one another's way and for aiming the weapons, we might estimate a hundred per cent efficiency of speed in firing in those days as 30 shots a minute. Comparing this with a modern machine gun firing 1200 rounds a minute, we have an increase in efficiency of 147,900 per cent!

As an instance of slow continuous raising of standards there may be cited that of the gradual increase in the sugar contents of beet root, the pounds of beet root required to obtain a hundred pounds of sugar being recorded as follows:

Year	Pounds
1836	1800
1842	1600
1857	1200
1871	1100
1894	750

It is not necessary to give further illustrations; standards are being constantly raised by the improvement of equipment and methods, and a cost system based on the use of standards should most certainly provide the means for promptly amending the cost records to reflect such adjustments in standards.

In spite of the apparent complexity of the formulas given, in actual practice by the methods formulated by the author their use in the determination and analysis of cost variations from month to month is an absolutely mechanical operation which can be quickly and accurately performed by the ordinary grade of office help.

The facility with which the author has been able to apply these formulas to meet successfully widely varying conditions would seem to indicate their soundness and practicability, and he ventures to believe that in these and similar formulas will be found the key to the solution of most fundamental cost problems.

TABLE 31. FORMULÆ TO APPLY IN THE DETERMINATION AND ANALYSIS OF COST VARIATIONS FOR THE DIFFERENT CLASSES OF EXPENSE

(To be used in conjunction with Table 32)

	Division of Cost	Charge Varying with Production (*p*)	Fixed Charge per Month (*b*)	Fixed Charge per Working Day (*c*)	Fixed Charge per Day Worked (*d*)
1	Comparison in Total...	*H-A*	*H-A*	*H-A*	*H-A*
	STANDARD VARIATIONS				
2	Revised standard....	*H-G*	*H-G*	*H-G*	*H-G*
		(*ar*) *F-G*	(*ar*) *F-G*	(*ar*) *F-G*	(*ar*) *F-G*
3	Alternate standard...	*H-F*	*H-F*	*H-F*	*H-F*
	PRODUCTION VARIATIONS				
4	Working days.....		*D-C*		
5	Idle time.....		*E-D*	*E-D*	
6	Daily production....		*H-E*	*H-E*	*H-E*
			(*a*) *F-E*	(*a*) *F-E*	(*a*) *F-E*
			(*ar* & *r*) *G-E*	(*ar* & *r*) *G-E*	(*ar* & *r*) *G-E*
	LABOR VARIATIONS				
7	Rates.....	*B-A*	*B-A*	*B-A*	*B-A*
8	Time.....	(*p*) *H-B*	(*b*) *C-B*	(*c*) *D-B*	(*d*) *E-B*
		(*a*) *F-B*			
		(*ar* & *r*) *G-B*			
	MATERIAL VARIATIONS				
9	Price.....	*B-A*	*B-A*	*B-A*	*B-A*
10	Quantity.....	(*p*) *H-B*	(*b*) *C-B*	(*c*) *D-B*	(*d*) *E-B*
		(*a*) *F-B*			
		(*ar* & *r*) *G-B*			
	SERVICE VARIATIONS				
11	Price.....	*B-A*	*B-A*	*B-A*	*B-A*
12	Quantity.....	(*p*) *H-B*	(*b*) *C-B*	(*c*) *D-B*	(*d*) *E-B*
		(*a*) *F-B*			
		(*ar* & *r*) *G-B*			
	EXPENSE VARIATIONS				
13	Amount.....	(*p*) *H-A*	(*b*) *C-A*	(*c*) *D-A*	(*d*) *E-A*
		(*a*) *F-A*			
		(*ar* & *r*) *G-A*			

TABLE 32. FORMULÆ TO APPLY FOR THE VARIOUS CLASSES OF EXPENSE IN THE DETERMINATION AND ANALYSIS OF COST VARIATIONS, FROM BASIC, ALTERNATIVE, REVISED AND REVISED-ALTERNATIVE-STANDARDS

(To be used in conjunction with Table 31)

Class of Expense	Basic Standard	Alternate Standard	Revised Basic Standard	Revised Alternate Standard
(*p*)	EXPENSE VARYING WITH PRODUCTION			
p-1	Labor $1=7+8(p)$	$1=3+7+8a$	$1=2+7+8r$	$1=2ar+3+7+8ar$
p-2	Material $1=9+10(p)$	$1=3+9+10a$	$1=2+9+10r$	$1=2ar+3+9+10ar$
p-3	Service $1=11+12(p)$	$1=3+11+12a$	$1=2+11+12r$	$1=2ar+3+11+12ar$
p-4	Expense $1=13$	$1=3+13a$	$1=2+13r$	$1=2ar+3+13ar$
(*b*)	FIXED MONTHLY CHARGE			
b-1	Labor $1=4+5+6+7+8b$	$1=3+4+5+6a+7+8b$	$1=2+4+5+6r+7+8b$	$1=2ar+3+4+5+6ar+7+8b$
b-2	Material $1=4+5+6+9+10b$	$1=3+4+5+6a+9+10b$	$1=2+4+5+6r+9+10b$	$1=2ar+3+4+5+6ar+9+10b$
b-3	Service $1=4+5+6+11+12b$	$1=3+4+5+6a+11+12b$	$1=2+4+5+6r+11+12b$	$1=2ar+3+4+5+6ar+11+12b$
b-4	Expense $1=4+5+6+13b$	$1=3+4+5+6a+13b$	$1=2+4+5+6r+13b$	$1=2ar+3+4+5+6ar+13b$
(*c*)	FIXED CHARGE PER WORKING DAY			
c-1	Labor $1=5+6+7+8c$	$1=3+5+6a+7+8c$	$1=2+5+6r+7+8c^*$	$1=2ar+3+5+6ar+7+8c$
c-2	Material $1=5+6+9+10c$	$1=3+5+6a+9+10c$	$1=2+5+6r+9+10c$	$1=2ar+3+5+6ar+9+10c$
c-3	Service $1=5+6+11+12c$	$1=3+5+6a+11+12c$	$1=2+5+6r+11+12c$	$1=2ar+3+5+6ar+11+12c$
c-4	Expense $1=5+6+13c$	$1=3+5+6a+13c$	$1=2+5+6r+13c$	$1=2ar+3+5+6ar+13c$
(*d*)	FIXED CHARGE PER DAY WORKED			
d-1	Labor $1=6+7+8d$	$1=3+6a+7+8d$	$1=2+6r+7+8d$	$1=2ar+3+6ar+7+8d$
d-2	Material $1=6+9+10d$	$1=3+6a+9+10d$	$1=2+6r+9+10d$	$1=2ar+3+6ar+9+10d$
d-3	Service $1=6+11+12d$	$1=3+6a+11+12d$	$1=2+6r+11+12d$	$1=2ar+3+6ar+11+12d$
d-4	Expense $1-6+13d$	$1=3+6a+13d$	$1=2+6r+13d$	$1=2ar+3+6ar+13d$

Additional Illustrations of Uses of Tables 31 and 32

Illustration 2

Class b Expense; Fixed Monthly Charge; Revised Standard

Character of expense, foreman paid fixed monthly salary.
Class of expense, fixed monthly charge (Class *b-1*).
Standard used for determining operating efficiency (revised).
Formula per Table 32: $1 = 2 + 4 + 5 + 6r + 7 + 8b$
Above formula expanded to terms of Table 31:

$$H\text{-}A = H\text{-}G + D\text{-}C + E\text{-}D + G\text{-}E + B\text{-}A + C\text{-}B$$

Standard Data

Standard working days in month	25
Standard pay per month	$125.00
Standard production, tons	250
Standard cost per ton	$0.50

Revised Standard

Production, tons	312.5
Standard cost per ton	$0.40

Assumed Actual Case

Working days in month	23
Days actually worked	21
Foreman's salary raised to	$150
Production, tons	260

Comparative Data

A Actual at actual	$150.00
B Actual at standard	$125.00
C Standard cost for standard month as above	$125.00
D Standard cost for actual working days $\frac{23}{25}$ — times 125.00	$115.00
E Standard cost for days actually worked $\frac{21}{25}$ — times 125.00	$105.00

Standard Cost for Actual Production

G Revised standard 260 tons at $0.40	$104.00
H Basic or accounting standard 260 tons at $0.50	$130.00

Comparisons

1 Total, H-A 130.00-150.00	$20.00*
2 Standard revision, H-G 130.00-104.00	$26.00
4 Working days, D-C 115.00-125.00	$10.00*
5 Idle time, E-D 105.00-115.00	$10.00*
6 Production efficiency, G-E 104.00-105.00	$1.00*
7 Rate variations, B-A 125.00-150.00	$25.00*
8 Time, C-B 125.00-125.00	.....

*Indicates red figure signifying increase.

Illustration 3

Class d Expense; Fixed charge per day worked; Revised Standard

Character of expense, foreman paid by the day for every day his department is working.

Class of expense, fixed charge per day worked, labor (*d-1*).

Standard used for determining operating efficiency (revised).

Formula per Table 32: $1 = 2 + 6r + 7 + 8d$.

Above formula expanded to terms of Table 31:

$$H\text{-}A = H\text{-}G + G\text{-}E + B\text{-}A + E\text{-}B.$$

Standard Data

Standard working days in month	25
Standard pay per day	$5.00
Standard pay per standard month	$125.00
Standard production, tons	250
Standard cost per ton	$0.50

Revised Standards

Production, tons	312.5
Standard cost per ton	$0.40

Assumed Actual Case

Working days in month	23
Days department worked	21
Foreman's wages raised to	$6.00
Production, tons	260

Comparative Data

A Actual at actual	$126.00
B Actual at standard 21 days at $5.00	$105.00
C Standard cost for standard month	$125.00
D Standard cost for actual working days	$115.00
E Standard cost for days worked in department	$105.00

Standard Cost for Actual Production

G Revised standard 260 tons at $0.40	$104.00
H Basic or accounting standard 260 tons at $0.50	$130.00

Comparisons

1 Total	(*H-A*)	$130.00		
		$126.00		$4.00
2 Standard revision	(*H-G*)	$130.00		
		$104.00	$26.00	
6 Production efficiency	(*G-E*)	$104.00		
		$105.00	$1.00*	
7 Rates	(*B-A*)	$105.00		
		$126.00	$21.00*	
8 Time	(*E-B*)	$105.00		
		$105.00	.....	
	Totals		$4.00	$4.00

*Indicates red figure signifying increase.

ILLUSTRATION 4

Class b Expense; Fixed Monthly Charge; Alternate Standard

Character of expense, material used in repairs of equipment.
Class of expense, fixed monthly charge (*b-2*).
Standard used for determining operating efficiency (alternate).
Formula per Table 32: $1=3+4+5+6a+9+10b$.
Above formula expanded to terms of Table 31:

$$H\text{-}A=H\text{-}F+D\text{-}C+E\text{-}D+F\text{-}E+B\text{-}A+C\text{-}B$$

Standard Data

Standard material per month of 25 days	$250.00
Standard production, tons	5,000
Standard material cost per ton	$0.05

Alternate Standard

Standard material per month of 25 days	$400.00
Standard production, tons	4,000
Standard material cost per ton	$0.10

Assumed Actual Case

Working days in month	23
Plant operating, days	20
Material used at standard price	$300.00
Material used at actual price	$350.00
Production, tons	2,800

Comparative Data

A Actual at actual	$350.00
B Actual at standard	$300.00
C Alternate standard for standard month	$400.00
D Alternate standard for working days $\frac{23}{25} \times 400$	$368.00
E Alternate standard for days worked $\frac{20}{25} \times 400$	$320.00
F Alternate standard cost—actual production 2,800 tons at $0.10	$280.00
H Basic standard cost—actual production 2,800 tons at $0.05	$140.00

Comparisons

1 In total	(*H-A*)	$140.00		
		350.00		$210.00*
3 Variation in standards	(*H-F*)	140.00		
(difference between basic and alternate standard)		280.00	$140.00*	
4 Working days	(*D-C*)	368.00		
		400.00	32.00*	
5 Idle time	(*E-D*)	320.00		
		368.00	48.00*	
6 Production efficiency	(*F-E*)	280.00		
		320.00	40.00*	
9 Price	(*B-A*)	300.00		
		350.00	50.00*	
10 Quantity	(*C-B*)	400.00		
		300.00	100.00	
	Totals		$210.00*	$210.00*

*Indicates red figure signifying increase.

Illustration 5

Class b Expense; Fixed Monthly Charge; Revised Alternate Standard

Character of expense, material used in repairs of equipment.
Class of expense; fixed monthly charge (*b-2*).
Standard used for determining operating efficiency (revised alternate standard).
Formula per Table 32: $1=2ar+3+4+5+6ar+9+10b$.
Above formula expanded to terms of Table 31:

$$H\text{-}A=F\text{-}G+H\text{-}F+D\text{-}C+E\text{-}D+G\text{-}E+B\text{-}A+C\text{-}B$$

Standard Data

Standard material per month of 25 days	$250.00
Standard production, tons	5,000
Standard material cost per ton	$0.05

Alternate Standard

Standard material per month of 25 days	$400.00
Standard production, tons	4,000
Standard material cost per ton	$0.10

Revised Alternate Standard

Standard material per month of 25 days	$360.00
Standard production, tons	3,000
Standard material cost per ton	$0.12

Assumed Actual Case

Same as previous illustration, i.e.:

Working days in month	23
Plant operating, days	20
Material used at standard price	$300.00
Material used at actual price	$350.00
Production, tons	2,800

Comparative Data

A Actual at actual	$350.00
B Actual at standard	$300.00
C Revised alternate standard cost for standard month	$360.00
D Revised alternate standard cost for working days in month $\frac{23}{25} \times 360.00$ (*C* above)	$331.20

E Revised alternate standard cost for days worked

$\frac{20}{25} \times 360.00$ (*C* above) $288.00

F Alternate standard cost of month's production

2,800 tons at $0.10 ..... $280.00

G Revised alternate standard cost of month's production

2,800 tons at $0.12 ..... $336.00

H Basic standard cost of month's production

2,800 tons at $0.05 ..... $140.00

Comparisons

1 In total	(*H-A*)	$140.00		
		350.00		$210.00*
2 Variation in standards	(*F-G*)	280.00		
(difference between alternate and revised alternate standards)		336.00	$56.00*	
3 Variation in standards	(*H-F*)	140.00		
(difference between basic and alternate standards)		280.00	140.00*	
4 Working days	(*D-C*)	331.20		
		360.00	28.80*	
5 Idle time	(*E-D*)	288.00		
		331.20	43.20*	
6 Production efficiency	(*G-E*)	336.00		
		288.00	48.00	
9 Material price	(*B-A*)	300.00		
		350.00	50.00*	
10 Material quantity		360.00		
	(*C-B*)	300.00	60.00	
	Totals		$210.00*	$210.00*

*Indicates red figure signifying increase.

CHAPTER XI

THE FUTURE OF COST ACCOUNTING

WHATEVER other reasons accountants may have to offer for their failure to bring cost accounting methods into line with modern developments in the industrial field generally, they certainly cannot claim that attention has not been drawn to the shortcomings and absurdities of what must still be regarded as the established methods.

Ten years ago Mr. Harrington Emerson presented a clear and convincing indictment of retrospective cost accounting methods. At that time he wrote as follows:

> There are two radically different methods of ascertaining costs: the first method, to ascertain them after the work is completed; the second method, to ascertain them before the work is undertaken. The first method is the old one, still used in most manufacturing and maintenance undertakings, the second method is the new one, beginning to be used in some very large plants, where its feasibility and practical value have already been demonstrated.
>
> The objections to the old method are not only that it delays information until little value is left in it, but that it is wholly and absolutely incorrect, mixing up with costs incidents that do not have the remotest direct connection with them, so that analysis of cost statements, as, for instance, repair costs per locomotive mile, does not lead to elimination of wastes. The advantages of the second method are not only that the costs must be ascertained before the work is begun, but that costs as finally tabulated are the real costs divided as to each unit, whether a single element or aggregated out of a million separate elements (1) into standard expense and (2) into avoidable loss. An analysis of costs so stated facilitates an almost inexorable elimination of inefficient conditions of all kinds, standard expenses being constantly standardized at new levels—wastes, the excess above standard costs, being constantly removed.

Another engineer who has drawn attention to the falsity of the usual methods of cost accounting was the late Mr. H. L. Gantt. In criticizing the common methods under which no distinction is made between legitimate costs of production and those due to inefficiency and idleness he states:

> Few of our business men have ever known what it costs to produce an article. They are the victims generally of a false cost-keeping system.

When an accountant wants to figure the cost of an article one of the first things he does is to throw in all the "overhead." Even though nine-tenths of the plant is absolutely idle 100 per cent of the whole investment is charged to the "cost of production." This is altogether misleading. If I rent two apartments in New York City at $100 a month each, then live in one and keep the other closed, I cannot honestly claim that it costs me $200 a month for a place to sleep.

All our accounting systems should contain another column, one showing the losses incurred through shutdowns, strikes, the idleness of any part of the plant, experiments that do not work, failure to get supplies, anything and everything which is not rightfully chargeable to the actual process of production. In one column, then, the actual cost of production would appear; in the other the manufacturer could see at a glance the tremendous cost of non-production and would be anxious to repair the leak. The reason he doesn't repair it oftener to-day is that his accountants have covered it up with pretty figures.

As Mr. Gantt suggests, the first step toward correcting an inefficiency is to determine its existence—in fact, as Mr. Walter H. Polokav states:

An accurate knowledge of the excess of expenses over the necessary cost of production leads almost inevitably to the discovery of means for eliminating this waste.

Our Lack of Accounting Methods

Though Mr. Emerson and other engineers have realized very fully the defects in the usual cost accounting methods and have clearly foreseen the direction which cost accounting in the future must surely follow, it must be admitted that they have given very little detailed information as to the methods to be adopted to realize the results demanded. Apparently they have not fully realized that the application of their principles involves a complete revolution in accounting thought and technique and requires a drastic readjustment of ideas on the part of accountants as to the fundamental principles of cost accounting. It is to be greatly regretted that the engineering and accounting professions have delayed so long in combining forces toward the elimination of what is probably the most serious defect in the industrial machine of to-day.

The author ventures to believe that in this volume he has described methods which represent the practical application of the ideas advanced in the quotations given, and these methods indicate at least in a measure the path to be followed in order

to release the industrial world from the shackles of the cumbersome and inefficient methods of cost accounting which are still inflicted on the long suffering manufacturer. A consideration of the methods illustrated in preceding chapters will clearly demonstrate how closely the results obtained by their use parallel those called for by Mr. Emerson when he wrote:

> When a simple system of stating all costs—whether for a single task for man or machine, or for all a man's work for any period, or for all the work of a gang or department, or for a whole plant—is available; when this system permits parallel statement of actual and standard costs—then the whole problem is well-nigh solved, patience, persistence, fidelity, and high ideals accomplishing the results, through the use of staff specialists.

Mr. Gantt's desire for a system of cost accounting which will show in one column actual costs of production and in another costs of non-production is also met in the plans described, for in the manufacturing efficiency statements illustrated the effect of non-production is clearly and unmistakably shown by the red figures which indicate increases in costs as compared with standard.

In addition, however, to meeting the demands of the operating division by furnishing complete information relative to costs and efficiencies, a properly designed system of predetermined costs is of inestimable value to other divisions of the business, particularly that of sales.

The Impossibility of Providing Reliable Current Information by Retrospective System

It is hardly an exaggeration to say that in concerns manufacturing a complex product and operating retrospective systems of cost accounting the sales manager is rarely ever provided with reliable information relative to current costs of manufacture. In the case of a concern manufacturing machinery where the operations involved in the manufacture of the parts incorporated in the machines finished in any month have extended over many months previous, the costs submitted by the cost department represent not the current cost of building these machines but a composite of several months' costs, and in times of fluctuating prices of material and labor such costs are likely to be distinctly misleading, to say the least. Under the methods described by the author, however, it is possible to furnish on

demand at any time a closely approximate current cost of any machine, even though it may consist of a thousand or more parts and involve ten thousand detail operations, and this without requiring revision of the detailed cost figures.

A further valuable feature presented by properly developed systems of predetermined or standard costs is the means afforded by their use of obtaining the most complete information relative to profits made on sales, and some illustrations have been given in earlier chapters in connection with this. The manufacturer of a varied product whose cost department provides him with reliable and comprehensive information as to his profits by lines, by salesmen, by territories and by classes of customers is the rare exception and not the rule, and it needs no very special gift of prophecy to foresee that the time is fast approaching when sales executives will demand that their cost departments furnish them with information which will enable them to conduct their business on the foundation of accurate information in place of guesswork or the judgment of competitors equally in the dark as to actual facts.

The Coördination of Accounting and Planning

An additional and valuable feature of standard costs is in connection with their coördination with the scientific planning and dispatching of work through the shops, a properly designed system of standard or predetermined costs not only enabling the cost department records to reflect the results obtained by the planning department but also rendering it possible for both departments to coördinate their routine work to their mutual benefit. In Figures 9 to 12 (Chapter V) and Figures 13 to 16 (Chapter VI) there was illustrated a coördinated cost, planning, and production system to meet complex conditions, under which the scientific planning and dispatching of work is absolutely coördinated with the scientific determination of costs, with the result that duplication of work is eliminated and the cost and planning records so dovetailed and harmonized that reference can be made from one to the other with facility. Under such a coördinated system the planning records provide an interpretation of the causes underlying inefficiencies disclosed by the cost records, and the latter being expressed in terms common to both cost and planning departments are of material assistance to the planning supervisor in adding significance to the informa-

tion appearing on his own records by expressing these in terms of dollars and cents.

An outstanding defect of the average planning and production system introduced by engineers is the disregard of the importance of coördinating the planning and costing functions and the entire separation from the cost system of many otherwise admirable planning systems when these should logically be combined cannot fail to reduce the effectiveness of both systems as well as to involve duplication of effort and excessive expense. A system of predetermined costs involves the use of standards of material quantities and of time, both of men and machines, and these standards should also be common to those used by the planning department. Unless this is so, unnecessary expense will be involved in maintaining separate records of standards and in addition there will be confusion between the cost and planning records owing to their lack of uniformity.

The time for establishing coördination between the cost and planning methods is at their inception, for unless the designers of the planning system have in mind the ultimate coördination of this system with the costs and provide for this in their plans, to obtain the full benefits which should be derived from such coördination will demand extensive revision of established methods, this involving the dual task of first forgetting the old, and second, learning the new.

Elasticity in Cost Accounting

Reference has previously been made to the lack of elasticity in the average cost system, information on the cost records being so compiled as to render it of little use except to meet the particular need for which it was originally compiled. The author in his work of substituting methods of cost predetermination for systems of retrospective cost accounting frequently finds cases where cost information over a few weeks old is practically valueless. He recently inspected a cost system of a company where tens of thousands of cost cards were on file, but as these did not state the date on which the costs were compiled it was not possible to ascertain whether they were figured when wages were on a pre-war basis or during the period of abnormal labor costs. In this case only the total labor was shown, as for instance, "planing $1.75," no hours being given.

In another case where the product manufactured was of a

complex character, a finished article comprising a dozen or more parts, not only were the quantities and prices of the material omitted, but material costs were shown in total for all of the parts comprising the article, a similar method being followed in connection with labor costs.

It is a fundamental principle in the methods employed by the author that all costs should be so compiled that they can be adjusted to the basis of current conditions with facility. Under these methods it is not necessary to refigure the detailed costs of the thousand or more parts entering into the standard cost of a machine in order to adjust this cost to the basis of current material, labor and burden rates. When a change in methods of manufacture results in the substituting of parts or the elimination or changing of operations it is necessary to revise the standard costs to conform to this change, but this is a different matter to requiring the refiguring of some ten thousand detailed costs owing to a change in the wage scale or an increase in the price of grey-iron castings.

The Advantages of Standard Costs

A number of illustrations have been given in the preceding chapters of the value of standard costs in bringing cost information to a focus—of showing in one figure how the costs of the whole plant for a period compare with standard. A further advantage previously referred to is in connection with bringing to a uniform basis efficiency statements compiled at different times and in comparison with varying standards.

Obviously, standards are constantly changing. As Mr. Emerson states: "Staff standards are infinite and ever-changing. The best practice of yesterday is the laughing stock of to-day." But a great proportion of the value of efficiency information compiled is lost if there is no way of showing the costs of to-day in comparison with the standards of yesterday. Under the method illustrated in Figure 22 in addition to showing actual costs in relation to adjusted standards these are also shown in relation to a base standard, so that efficiency data compiled at any time is always comparable with that compiled at any other time.

It is a well-known fact that specialists are in a degree apt to lose their sense of relative values and to lay undue emphasis on the importance of the sphere in which their interests are in

DEPARTMENTAL EFFICIENCY STATEMENT PREVIOUS TO REVISION OF STANDARDS

— PERIOD A —

	ACTUAL COST IN PERIOD	BASIC STANDARD COST IN PERIOD	INCREASE OR DECREASE COMPARING ACTUAL COST WITH BASIC STANDARD		CURRENT STANDARD		INCREASE OR DECREASE COMPARING ACTUAL COST WITH CURRENT STANDARD	
			INCREASE	DECREASE	% OF BASE	AMOUNT	INCREASE	DECREASE
Direct Labor	5500 00	5000 00	500 00					
Indirect Labor	1000 00	1250 00		250 00				
Machine Repairs	1350 00	1500 00		150 00				
Tools	1250 00	1000 00	250 00					
Supplies	600 00	500 00	100 00					
Power	900 00	1000 00		100 00				
Supervision	600 00	500 00	100 00					
TOTAL	11200 00	10750 00	950 00	500 00				

FIRST REVISION OF STANDARDS

	% OF BASIC STANDARD
Direct Labor	105
Indirect Labor	75
Machine Repairs	85
Tools	110
Supplies	110
Power	80
Supervision	120

DEPARTMENTAL EFFICIENCY STATEMENT MADE IN ACCORDANCE WITH FIRST REVISION OF STANDARDS

— PERIOD B —

	ACTUAL COST IN PERIOD	BASIC STANDARD COST IN PERIOD	INCREASE OR DECREASE COMPARING ACTUAL COST WITH BASIC STANDARD		CURRENT STANDARD		INCREASE OR DECREASE COMPARING ACTUAL COST WITH CURRENT STANDARD	
			INCREASE	DECREASE	% OF BASE	AMOUNT	INCREASE	DECREASE
Direct Labor	5100 00	5000 00	100 00		105	5250 00		150 00
Indirect Labor	1100 00	1250 00		150 00	75	937 50	162 50	
Machine Repairs	1400 00	1500 00		100 00	85	1276 00	125 00	
Tools	1050 00	1000 00	50 00		110	1100 00		50 00
Supplies	650 00	500 00	150 00		110	550 00	100 00	
Power	950 00	1000 00		50 00	80	800 00	150 00	
Supervision	580 00	500 00	80 00		120	600 00		20 00
TOTAL	10830 00	10750 00	380 00	300 00		10513 50	537 50	220 00

DEPARTMENTAL EFFICIENCY STATEMENT FOR DEPARTMENT HEAD ELIMINATING COMPARISONS WITH BASIC STANDARD

DEPT. MONTH OF

	ACTUAL	STANDARD	INCREASE	DECREASE
Direct Labor	5100 00	5250 00		150 00
Indirect Labor	1100 00	937 50	162 50	
Machine Repairs	1400 00	1275 00	125 00	
Tools	1050 00	1100 00		50 00
Supplies	650 00	550 00	100 00	
Power	950 00	800 00	150 00	
Supervision	580 00	600 00		20 00
TOTAL	10830 00	10513 50	537 50	220 00

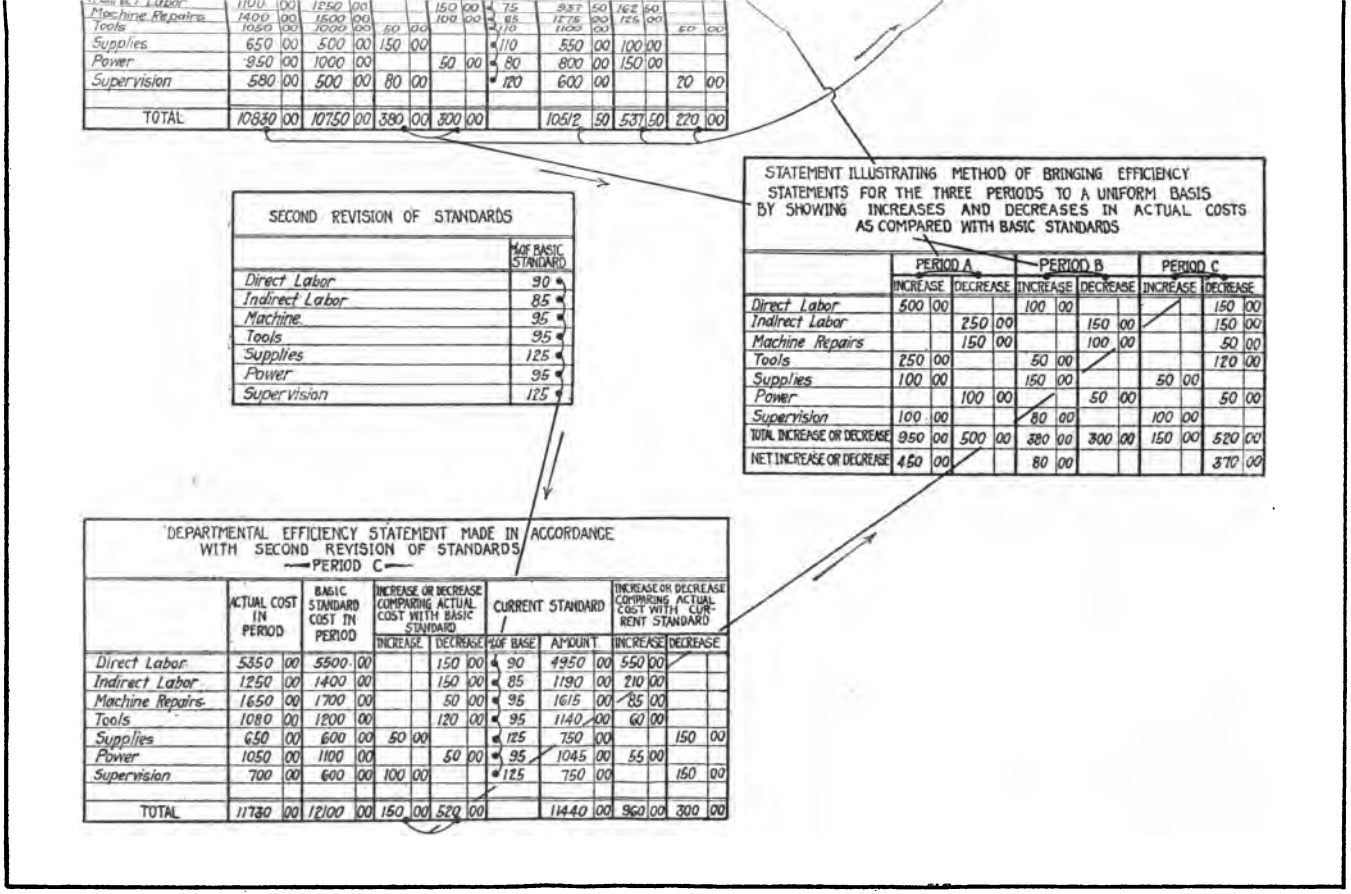


FIG. 22.—Diagram illustrating simple and effective means of revising standards without necessitating refiguring of detailed costs and of bringing efficiency statements compiled for different periods to uniform basis.

[*To face page 226.*

the main confined, and the statements of engineers supporting the contention of the author that inefficient cost accounting methods are a serious drain on industrial life have been quoted, with the hope that to some extent at least they will offset the suggestion that as a result of too long contemplation of cost accounting problems the author attaches too much importance to this field of effort. The author does not contend that solution of all industrial problems will be found in the introduction of efficient methods of cost accounting, but he does believe with Mr. B. A. Franklin that the installation of adequate methods of cost accounting is the basic and fundamental factory improvement, and claims further that inadequate methods of cost accounting are a serious handicap also to both the sales and financial divisions of a business. The successful operation of a ship demands many things over and above the ability to determine the position of the vessel at any given time, but efficiency in the engine room will be of little moment if through poor navigation the ship is run upon a rock, and an adequate system of cost accounting is the only medium through which the exact position of a business can be continuously and correctly determined.

The Coming Revolution in Cost Accounting

If the author is correct in his contention that the retrospective systems of cost accounting which are followed in the great majority of manufacturing institutions are totally unfitted to meet the legitimate demands of the modern executive it would seem reasonable to suppose that we are on the eve of a widespread revolution in cost accounting methods, for once the movement toward the introduction of better methods of accounting becomes at all general no manufacturer who expects to hold his own will be able to afford to retain accounting methods greatly inferior to those of his competitors. If one manufacturer operates on the basis of precise and immediate information and the other without, it is only a question of time when the law of the survival of the fittest will bring the latter into bankruptcy.

Cost accounting requires to be elevated from its present condition of empiricism to that of a science. It must no longer be regarded as a pleasant relaxation for professional accountants to take up occasionally when the pressure of financial audits and investigations is relieved. The design of systems of cost account-

ing to meet the demands of modern complex business demands specialized knowledge which can only be obtained when years of practical experience are added to a natural aptitude for this class of work.

The Opportunity Before Accountants

Nature in her law of the survival of the fittest has provided that the curve of evolution should be an ascending one and no institution can permanently continue in competition with one infinitely more efficient. The question for American industry to decide to-day, however, is whether it can afford to wait for a gradual evolution toward better things, whether it can afford to permit the blindness of its accounting advisers to remain a drag on progress at a time when we need to strain every nerve to render our leadership in the world of business secure. The inefficiency of the accepted cost accounting methods is not merely an academic problem, it is not restricted to the counting house or to conventions of public accountants, it strikes at the very roots of industrial life. It is a serious matter that at a time when more than ever before we need coördinated effort in all departments of business we find so important a division as that of accounting entirely out of harmony and adjustment with the aim and purpose of business in general.

These transitional times offer the accounting profession a great opportunity and a great responsibility. What is required is accounting skill combined with the proper viewpoint. Of these two the latter is the more important and it is this the accountant lacks. If he should fail at this critical time to adjust his viewpoint it would seem inevitable that in the field of cost accounting, at least, he will have to step aside. If this should happen, however, we will lose vital time, for as many an engineer has found to his sorrow the requisite training in the application of accounting principles cannot be acquired in a limited time, and the logical leader in bringing cost accounting into line with modern industrial thought and progress is the professional accountant. Though not primarily directed to them, accountants would do well to consider this message from the pen of Glenn Frank, in his recent book "The Politics of Industry":

> Whenever in these creative moments in history when the accustomed calm and conservation of the popular mind has been broken up and Society has had to choose between trained blind men and untrained men of vision,

Society has chosen the untrained men of vision. The leader whose vision is right and whose purpose is sincere will acquire the training in time, while the trained man who persists in clinging to the passing order is a dead weight. *But there is no final reason why the trained leadership of one period of development should not become the fittest servant of the next period*

If every manufacturer would review his cost accounting system and ask himself whether it fully meets requirements—whether it enables him to learn what his current costs of production are, where and to what extent he is manufacturing inefficiently and where he is making his profits and where not—the problem would soon be solved, for the demand for improvement would be so insistent and the opportunities for skilled cost accountants so great that this field would attract to it men of calibre of a par to that now required by the engineering and other professions.

There is no real justification for regarding costs solely from the retrospective viewpoint, and the development of cost accounting along historical lines by professional accountants is due to the fact that most of the work undertaken by them is in the nature of the verification of past records and the investigation of past transactions.

There is nothing particularly modern in the basic conception of cost predetermination. Throughout the ages it has been realized that the path of wisdom is to "look before you leap" and the world has always directed a special scorn towards the man who started to build a mansion and whose funds petered out before the undertaking was completed. These monuments to lack of foresight are generally pointed out to enquiring visitors under some such contemptuous title as "Smith's Folly" and one can well imagine the subdued laughter—prompted by the recollection of some half finished tower mouldering upon a neighboring hillside of that audience, some two thousand years ago, when it heard these words:

> For which of you intending to build a tower, sitteth not down first, and counteth the cost.

THE END

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